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## BRIEFLY TOLD.

THE FODELL AND ADAMS PAPERS.—Next in order in our report of the American Association proceedings, come the papers submitted respectively by Mr. W. P. Fodell and H. C. Adams, both of Philadelphia. Mention of the latter city brings to mind the odd fact that the Quaker City did nobly this time in the matter of furnishing authors, as no less than four of the ten communications were presented by gentlemen who claim a residence in the chief city of the Keystone State. Mr. Fodell saw fit to present his conclusions on a sound method of bookkeeping for gas companies, and he was listened to with close attention. This, of course, was but natural, if not inevitable; for Mr. Fodell was early in the field, in fact a generation ago, with a set form for keeping gas company's accounts. This brochure, which was entitled "Fodell's System of Bookkeeping for Gas Companies," met with a good sale—two editions of it were published and sold to the last copy—and it may be said with truth that its contents can now be traced as furnishing chapter and verse for many practices extant to-day in the accounts of many gas companies. Mr. Fodell, then, speaks as a veteran, whose work has stood the test of commercial firing, and now he presents a target with a face smoothened out from the dents that that firing caused. The scheme outlined by him is very simple, as all bookmaking bases should be, and from it the reader, who bears in mind Mr. Fodell's brochure of a generation ago, will require no hint to put him in the way of thinking that the author has kept pace with the day and time of current practice. He has put his case so plainly that the commenter is at a loss for pegs whereon to hang an explanation, which ought to be the greatest meed of praise that an author may receive. We find, however, in his concluding paragraph, a reflex of the thoughtful mind that always guided him in safety, and enables him to-day to separate unerringly the truth from Nationalistic falsehood, as it equally guides him in keeping debit figures from the credit page. The paper in its entirety is, as it seems to us, a virtual endorsement, too, of the action of the Western Association's Committee that was appointed not long ago to make some approach towards securing uniformity in gas accounts.

TURNING from the Fodell paper, with its tendency to put one in mood for reflection, we are confronted with another that appeals with no less force to one's quieter moments. Mr. Adams' ready pen and receptive mind have formed a combination that is said to belong to the historian. Indeed, his "Gas Coals of the United States" is about as finished a bit of work as any that we have ever read, and forms a fit companion for the article of a kindred nature—"Provincial Gas Coals," if we mistake not, was the substance of its title—read by Mr. Jas. D. Perkins at an earlier period in the history of the Association. The members ought and doubtless do take pride in the knowledge that within their ranks can be found men qualified to do such thorough justice to the work which they are either designated or self-appointed to perform. Mr. Adams' paper is most complete, and its value as a work of reference is real and permanent. Even the tyro can appreciate the research, collaboration and study that have been put into it. Connected as he is with one of the greatest gas coal producing companies in the country, not the faintest suspicion of advertising attaches to it, or to him. From a literary point of view it is excellent, but of his capacity in this direction our readers

have long ago had ample proof, in his communications to them through our pages. In fact, in order that he might reap substantial reward for his work, we believe that such would come to him in good measure were we soon to receive a copy, from some publishing house, of a well-bound book bearing the title, "Gas Coals of the United States," by H. C. Adams, for review in our pages.

NOTES.—Oscar O. Wheelock, formerly Superintendent of the Brattleboro (Vt.) Gas Company, died at his home in that city, on the afternoon of Nov. 21.—The Easthampton (Mass.) Gas Company has purchased the property and franchise of the local People's Electric Light Company. The stockholders in the latter probably save themselves from loss.—Mr. Frank Jennings, formerly in charge of the Cottage city (Mass.) gas works, is to be Superintendent of the new plant at Framingham, Mass. —The proprietors of the gas works at Woodbury, N. J., are making a test of a wood gas system.—Beginning to-day, the price of gas at Keene, N. H., is to rule at $2, instead of $2.50.—The Committee on Gas and Light, of the Los Angeles (Cal.) Council, have recommended that the application of George W. King for a franchise for the operation of a gas works in that city be denied.

[A paper read before the Society of Gas Lighting.]

## A Plea for Uniformity in Certain Castings.

By MR. A. H. STRECKER.

When erecting new works or overhauling old apparatus, the gas manager is often confronted by a difficulty—one with which no doubt you are all familiar—and that is the wide difference in size and construction of the connecting flanges or bells of the pipes and special castings that are to be used.

Of course, if the pieces all come from the same shop, there will be no trouble, but if it so happens that two manufacturers furnish different parts of one piece of work, or if new piping is to be connected to old work of another make, then there will be bother. No two shops make their fittings alike, and a "Floyd" spigot will often not enter an "Isbell-Porter" bell; nor would size and templet of a "Rowland" flange agree with that of any other maker. Then there will be drilling and chipping and swearing in plenty.

The same trouble has been experienced in other parts of the world In Germany, for instance, to surmount the difficulty, the Society of Gas and Water Managers appointed a commission to formulate standard rules for the construction of pipes and special castings, and the Society finally induced the manufacturers of these articles to adopt the rules, so that there is now in that country, practically, only one pattern for a given size of pipe or fitting.

It seems to me that it would be eminently proper for our Society to take this matter in hand; perhaps, also, to select a committee to confer with other associations of Engineers and manufacturers for the purpose of devising a scheme by which the object in view could be attained—*i.e.*, uniformity in patterns for pipes and fittings that are used in the construction of gas works, as well as in the laying of street mains.

Many of the street fittings, as at present made and sold by the pipe foundries, are of ridiculous patterns, often having spigots that are too short to be properly caulked into a bell; plugs that may go into a bell, but will never come out again whole; sleeves that are too short, and so on. Very frequently these pieces are twice as heavy as need be, burdening the work with unnecessary expense.

Once a standard for these castings is set up it will be within the power of the members of this and other Societies to compel the manufacturers to follow it. All you have to do is to ask for standard castings, when drawing specifications for new work, or ordering pipes, etc., and you will get them. Let us all assist, and we will soon accomplish a needed reform.

## The Market for Gas Securities.

The quiet of the past week in Wall street is in queer contrast with the hurly-burly of the preceding seven days, and perhaps one lesson that may be taken from the whole affair is that Wall street is not nearly so potent a factor in the commerce of the country as its directors would have us imagine. If the country is able to pay a fair rate of interest for its loans, Wall street ought to, and eventually will, understand that it can have its pound of flesh, and no more; whereupon the time will have arrived when Gould may season his diet with sage, but without any lamb to grace the board. Yes, Wall street will in time feast on herbs. Stocks were all stronger, although towards the end of the week realizing sales caused something of a decline from highest prices made. Consolidated sold to-day (Friday) at 96½, and Chicago gas was dealt in at 37½. The outlook for higher prices is very bright.

[Continued from page 730.]

[OFFICIAL REPORT—REVISED BY THE SECRETARY.]

## EIGHTEENTH ANNUAL MEETING OF THE AMERICAN GAS LIGHT ASSOCIATION.

HELD AT SAVANNAH, GA., OCTOBER 15, 16 AND 17, 1890.

SECOND DAY—MORNING SESSION.

REPORT OF COMMITTEE ON PRESIDENT'S ADDRESS.

Mr. Cowdery, from the Committee on President's Address, having announced that the Committee was ready to report, Vice-President Boardman, at the request of the President, assumed the Chair. The report (read by Mr. Cowdery) is as follows:

In making the report upon the President's Address, your Committee found an unusual task before them. The Address contains so many points of interest, and so many valuable suggestions, that a great deal of time was necessary in order to give to each the proper consideration.

Your Committee respectfully recommends the close and earnest study of the masterly and unique presentation of the many points of interest embodied in the President's Address.

Your Committee especially calls attention to his remarks upon the municipal control of lighting, and its consequent exhaustive treatment.

The experience of conducting, with commercial success or failure, the manufacture of fuel gas must be, by virtue of the importance of such data, highly valuable to the modern gas manager.

Of equal interest, and treated with consummate skill, will be read the results of the increase of electric lighting.

We regret that it should be necessary to stimulate the lagging interest in the financial prosperity of the Association, of so large a number of the members, by calling attention to it, and it is to be hoped that the next report of the Treasurer will show the healthy result of such a stern reminder.

We concur most heartily with and indorse the manly stand taken by our President in reference to establishing and maintaining the independence of this Association, and to this effect we recommend the adoption of the following resolution:

"That at all subsequent meetings no hospitality, in the shape of a banquet, be accepted by the Association, in the city visited."

The importance of designating beyond any peradventure the question of the tenure of office is concisely and clearly stated. In order to obtain the legality of the beginning and expiration of the term of office, and to avoid the misinterpretation likely to result from the ambiguity of the existing clause in the Constitution, we recommend the adoption of the following resolution:

"That it is the sense of the Association that, under the provisions of the Constitution, the officers-elect should enter upon the discharge of their respective duties on the Saturday succeeding the third Wednesday in October of each year."

And your Committee further recommends to the Council the following change in the Constitution, for final recommendation:

"That the election of officers take place immediately before the close of the final business session of the Association."

The approaching World's Fair demands that the large and varied interests of the gas profession be treated and displayed in a generous and liberal manner. In order to accomplish this, and to show the wonderful progress and genesis of the industry, it will be found useful and equitable to enlist the enthusiastic services of the kindred manufacturing industries which are integral to our business. To this effect we recommend to the Council that the ideas suggested by the President be carried out.

E. G. COWDERY, I. C. BAXTER,
O. B. WEBER, W. H. BAXTER, } Committee.
A. G. GLASGOW, G. S. HOOKEY,

Mr. Cleary—I desire to ask whether the Address of the President is to be printed, except in the minutes.

Mr. Cowdery—It was not intended to so recommend.

The Chairman—I think the President's Address is not separately printed unless so recommended by the Association; but it is printed in the minutes, and appears in the JOURNAL.

Mr. Cleary—That is what I want to know; because some of us who are engaged by municipal corporations would like an opportunity to digest the Address.

The Chairman—You have heard the report of the Committee, and it seems to me that it covers quite a number of items; and it might be well, as the Address treats of such a variety of subjects, that you take up the recommendations of the Committee seriatim, cull out what you wish

to pass, amend what you desire to amend, and then pass the report as a whole when you have thoroughly discussed it. Shall we adopt it as a whole, or take it up in sections?

On motion of Mr. Fodell, it was determined to receive the report, and to discuss its recommendations separately.

The Chairman—The report is received. The first note I have made is in respect to municipal control. Is there anything you wish to do with that, or any recommendation further than the importance that has been attached to it in the report of the Committee? If there is no objection I will read that recommendation again: "Your Committee respectfully recommends the close and earnest study of the masterly and unique presentation of the many points of interest embodied in the President's Address. Your Committee especially calls attention to his remarks upon the municipal control of lighting, and its consquent exhaustive treatment."

On motion of Mr. Harbison, that recommendation of the Committee was adopted, without discussion.

The Chairman—The next point brought out is the increase of electric lighting, to which the Committee called the attention of the body, regretting that it is necessary to call our attention to it in order to stimulate and protect our own industry. What will you do with that?

Mr. Harbison—I move that the suggestion be adopted. (Carried.)

The Chairman—The third point covered is the endorsement of the independence of the Association, and the resolution that, in effect, we furnish our own banquets hereafter.

Mr. Littlehales—I think that is an eminently suitable resolution to be adopted by the Association. While every member must feel that the places we have visited from time to time have been unlimited in their hospitality, yet I think the time has come when the Association should take an independent stand in that matter and decline all future hospitality. I have much pleasure in moving the adoption of that item.

Mr. Lansden—Do I understand this is a recommendation that we shall not have a banquet, or does it only leave it in such a way that we can refuse or accept hospitalities at points where we meet? With regard to having a banquet, will not that question come up each year; or will it be settled this year for the next? And if we adopt that, do we settle the idea of whether or not we are to have a banquet and pay for it ourselves?

The Chairman—There is no second to the motion, and if you will allow me, in order to bring it more fully to mind, I will read the resolution as it stands, and then you can discuss it more intelligently: "That, at all subsequent meetings, no hospitality in the shape of a banquet be accepted by the Association, in the city visited." I think the point is perfectly clear.

(Mr. Harbison seconded the resolution offered by Mr. Littlehales.)

Mr. Goodwin—I would like to make a suggestion. While I concede that the resolution is eminently proper, still, if you ever come to Philadelphia we do not want to be blocked out, should we feel disposed to tender you the hospitalities of the City of Brotherly Love. If the resolution could be changed so as to read that it is the sense of this body that it should furnish its own banquets, the door is left open to such of us as might want to extend hospitality to do so. If that resolution prevails as it is, it would shut us out entirely. If it could be modified in the manner suggested, so as to make that the expression of the sense of this meeting, I should be very glad to help pass it, and I know some others who would like to see that limitation.

Mr. Harbison—I hope the resolution as proposed by the Committee will not be changed in any respect; for it does not cut off our friends in Philadelphia or anywhere else from properly taking care of the ladies who may come with us, or from extending any other little hospitality our hosts may see fit to tender us—except the banquet. It only has reference to the banquet. There are many places where we can have a social dinner party on Mr. Goodwin's invitation, or on that of other distinguished men in Philadelphia, without having a set banquet.

Mr. Littlehales—There is no reason why Mr. Goodwin's suggestion should be favored. We know his largeness of heart, for we have had specimens of his treatment; and if we should have the pleasure of meeting in Philadelphia again, I have no doubt there would be the same large-heartedness still. I trust the motion will pass in its entirety, as it stands.

(The announcement of the Chairman that the motion was carried was received with applause.)

The Chairman—The next recommendation is as to the tenure of office. Following the preamble stating the necessity to fix some decided date for tenure of office, the resolution reads: "That it is the sense of the Association that, under the provisions of the Constitution, the officers elect should enter upon the discharge of their respective duties on the Saturday succeeding the third Wednesday in October of each year."

(On motion of Mr. Littlehales the recommendation was adopted.)

The Chairman—The fifth point to which attention is called is the change with regard to the election of officers—carrying it over from the third Wednesday, to the last day of the meeting which convenes on the third Wednesday.

Mr. Harbison—I move that recommendation be referred to the Council.

The Chairman—I will read the recommendation so that you will understand it: "The Committee recommends the following change in the Constitution, for final recommendation: '"That the election of officers take place immediately before the close of the final business session of the Association."'

Mr. Harbison—I move the adoption of that recommendation.

Mr. A. C. Humphreys—If that resolution is adopted will the Council be able to act on it so that it shall come before this meeting, and so that it can be acted on at the next meeting?

Mr. McMillin—Yes; I think we can.

The Chairman—I think it will be necessary to have the Council meet before the close of this business meeting. I may be in error, but I think that that is what would have to be done if it is adopted.

Mr. A. C. Humphreys—Could the Council have that meeting and act on the recommendation so that the Association can take it up provided they agree with the suggestion.

The Chairman—I think the Council will promptly attend to anything that the Association requests. Are you ready for the question? (The motion was carried.) The recommendation is adopted. The Council will please take notice, and act accordingly. The sixth item before me is that with respect to the World's Fair. A suggestion is made by the President with respect to adding associate members to the Committee. That recommendation is taken up by the Committee on the President's address, who think that "It will be found useful and equitable to enlist the enthusiastic services of the kindred manufacturing industries which are integral to our business;" and to that end they recommend to the Council that the ideas suggested by the President be carried out.

Mr. Littlehales—I move the adoption of that. I understand this is to be taken in connection with the suggestion made in the President's address that no expense be incurred by the Council except they have the money in hand, so that it will not involve the Association in any expenditure.

The Chairman—I think the idea of the Committee evidently is that the recommendations of the President shall be taken in their entirety. It is moved and seconded that the recommendation of the Committee in this respect be adopted. Are there any remarks? (The motion was carried.) The resolution is adopted. Will you take up the report now as a whole?

Mr. Somerville—One other point I desire to call attention to, which I think you have perhaps overlooked among the recommendations of the Committee. The President made allusion to it. The subject is one which I have never before heard mentioned in a President's address. I was very sorry indeed that he was obliged to mention this subject. It was painful to me to hear it. It is painful for me now to speak about it. I think it is the duty of some member who is not an officer of the Association to call attention to it. Of course you all know to what I allude—the financial condition of the Association.

The Chairman—I overlooked that. I am very glad you have called the attention of the Chair to that point. It is a very important matter. The recommendation of the Committee in this respect is: "We regret that it should be necessary to stimulate the lagging interest in the financial prosperity of the Association, of so large a number of the members by calling attention to it, and it is to be hoped that the next report of the Treasurer will show the healthy result of such a stern reminder." What is your pleasure as to this?

Mr. Littlehales—I move the adoption of the report. I will simply call attention to it. We will suppose that the members have merely overlooked it—a thing which they ought not to do, since we are all so fond of cutting off the gas when our customers do not pay. (Laughter.)

Mr. A. C. Humphreys—If it be a proper question I would like to hear what penalty the Constitution affixes for the non-payment of dues, and I would like to have the Treasurer report what amount of dues he has collected at this session after the very urgent appeals he has made. A reference to the unpaid dues having been made twice already at this meeting, I would like to know how much effect the reference has had.

The Chairman—I believe that that is not quite in order on the present motion.

Mr. A. C. Humphreys—Is it not in order to ask for any information from the officers of the Association which will help us in forming an opinion on the subject before us?

The Chairman—That is proper, if you ask for information.

The Secretary—The Constitution says, Article 51: "No member who owes 2 years' dues shall be entitled to vote, or participate in the deliberations of the Association, or to receive a copy of the proceedings." The next Article reads: "Any member whose dues shall remain unpaid for a term of 3 years may be dropped from the roll of membership by a vote of the Council." On the other point I will say in reply to the question, that I have received the large sum of about $135, out of some $1,300 due.

Mr. A. C. Humphreys—May I ask one more question? How far have we followed the Constitution with regard to the distribution of records of proceedings? Do these members continue to get the proceedings, and has the Council been good natured about it, hoping that the dues would be settled up?

The Chairman—Perhaps the Secretary can answer that question.

The Secretary—Article 51 has not been enforced; Article 52, with regard to dropping members, has been enforced.

Mr. McMillin—I will say that we had a list made purposely and placed on the outside of the door, arranged alphabetically, so that each man could see whether he was two years behind or not, and we trusted to his honor not to take part in the discussions if he found himself two years behind.

The Chairman—I think Mr. Humphreys' question was directed to the distribution of the reports; was it not?

Mr. A. C. Humphreys—Yes, more especially.

The Secretary—I will say, in reply to that, that I have been instructed by the Council, when I had Vol. 9 prepared, not to send it to any member owing two years' dues.

The Chairman—I think that answers Mr. Humphreys' question.

Mr. Littlehales—I would like to ask, in this connection, whether it is the understanding of the rule that when a member has paid up his arrears he retains his membership.

The Chairman—I think so.

Mr. Littlehales—He is then reinstated?

The Chairman—That is a matter which would properly come before the Council, I think. The Constitution provides that, "A member dropped from the roll for non-payment of dues may, upon paying the amount he owes the Association, be reinstated at the option of the Council."

Mr. Lansden—I do not like to have the impression go out that a body of gentlemen who meet here as we have are not paying our dues; and I want to ask if it is not true that a vast majority of those who stand as delinquents are members who are not here. I do not wish to have the impression go out that those of us who are here, and a great many who have not the privilege of meeting with us, have not paid their dues. In looking over the list I see that a large number of the delinquents are members who are not present at this meeting. Although they are marked as delinquents, it is probable that they will pay their dues in a short time.

The Secretary—We only have about 150 members here, out of 340. Of course, a great many of the delinquents are not present. I have not checked those who are present on that list, and so I cannot say just how many are present here who have not paid.

The Chairman—Are there any further remarks on the question of adopting the President's Address? It has been moved and seconded that the report of the Committee on the President's Address be adopted. (The motion was carried. The report was adopted.)

The Chairman—We will pass to the next business. Is the Committee on the place of the next meeting ready to report?

### Report of Committee on Place of Meeting.

Mr. Littlehales, from the Committee, submitted the following report:

To the President and Members of the American Gas Light Association: Gentlemen—Your Committee on next place of meeting beg to report that cordial invitations have been received from Hartford, Conn., and from Montreal, Can., and after full consideration of the question recommend that the city of New York be the next place of meeting.

Respectfully submitted, John S. Bush, Chairman."

Mr. Harbison—Perhaps, as the one who extended to the Association an invitation to visit Hartford, Conn., at the next meeting, it would be proper for me to say that the Committee have selected the city of New York on my suggestion, although I had extended an invitation for Hartford. The reason for this is that my invitation for Hartford was extended before I was honored by the Association with an election to the Presidency for the ensuing year, and, feeling that I could not properly perform the duties of host and of presiding officer at the same time, I suggested to the Committee that they select some other place than Hartford for the next meeting—renewing, however, the invitation for two years from this time—to which the Committee unanimously agreed. I trust that every member of the Association will make it a special item of record that the invitation is given now (as I propose to be the first in the field) to hold the annual meeting of 1892 in the city of Hartford. I therefore move that the recommendation of the Committee be adopted, with the proviso in my own mind, and expressed here, that no other point may be thought of by any of you as the proper place for holding the second meeting from this date, except that of Hartford, Conn.

The Chairman—The motion is that the report of the Committee be adopted. (The motion was carried.) The report is adopted. New York will be the place of the next meeting. We will now listen to the paper of Mr. Fodell.

Mr. W. P. Fodell, of Philadelphia, Pa., read his paper, entitled

## SUGGESTIONS OF METHODS AND SYSTEMS FOR RECORDING THE HISTORIES AND ACCOUNTS OF GAS LIGHT COMPANIES.

Each and every business requires a different system for keeping its history and accounts, if not in the principal books used, at least in the auxiliary ones.

The machinery and tools employed in manufacturing, the labor expended, and products obtained must be charged and credited respectively with their pecuniary value. The proprietors and the purchasers of the product must be registered, and their several accounts kept. The bills must be made, presented and collected. Finally, the profits or losses must be determined, and a division or assessment made among the proprietors.

In our particular field—the distillation of coal and other substances used for obtaining illuminating gas and other products—I have prepared what I believe a proper division of the business into four departments, each having its distinct field and system of books, those of the first three converging into the last as follows:

*First.* Engineer's Department, for manufacture and distribution of the products.

*Second.* Register's Department, for registration of consumers.

*Third.* Receiver's Department, for rendering and collection of bills and forwarding collections to Treasurer's Department.

*Fourth.* Secretary and Treasurer's Department, for recording the acts of the managers, general supervision of the accounts and books, receiving all moneys, payment of interests, dividend and purchases.

In large works these departments would be sub-divided, and in small ones combined.

It is of prime importance that a careful and accurate note of each event, and record of each receipt and expenditure be made for present and future reference, that the exact history and cost of the operations may be determined at any time during the entire life of the concern. I suggest, therefore, that a complete set of books for this purpose be opened when the first bond is given or the first certificate of stock issued, and that the distinct charges to capital and profit or loss be accurately stated in each instance. There may at times be doubt in the mind of some as to which account certain expenditures should be charged. Some accountants fall into error by charging the expense of renewals to capital; but a moment's thought should correct this, when it is remembered that such items should properly be charged to profit and loss, for the reason that they take the place of once paid for machinery.

Betterments, such as extensions, additions and other improvements, in so far as they increase the capacity of the plant, would be properly chargeable to capital to the extent of the increased productiveness.

It is the custom of some manufacturing concerns, and it would seem a proper course to pursue, to charge, at certain periods, a per cent. of depreciation of the plant, where the machinery in use is being constantly worn away. This amount should be sufficient to provide funds for the erection of an entire new plant at the end of a limited number of years.

Other concerns rate their capital not upon the actual cost, but upon its productive value at the prevailing rate of interest. A corporation would be justified in increasing its assets by the appreciation of the real estate and any other assets.

Another important matter to be carefully attended to in our business is to prepare and keep a plan of the plant, including street mains, with space for additions and extensions. It would also be of great advantage if all the pipes, valves, etc., in and about the works be exposed, so far as practicable, so that easy access could be had for alterations, repairs or stoppages; and for the facility that would be afforded for the location and detection of leaks. It would be of great advantage to gas companies if, in laying out a town, the streets could be tunnelled sufficiently to lay all pipes, and even culverts therein—as is the case in parts of Paris. Our leakage account would then be almost nothing, so easily could we de-

tect, locate and remedy any leaks. The whole difference in the volume of gas between the station meter and the consumer would then be almost wholly condensation—except leaks from service pipes—and even these could be soon remedied if the serivce pipes were laid inside of larger pipes.

Before using the books of the subordinate department, reference to the books of the treasurer is necessary, beginning with those of bonds and stock certificates, which having been issued, an entry is made in the cash book noting the cash receipts therefrom. Upon the purchase of a site, credit is taken in the cash book for the amount paid. Like credits are taken for the cost of the erection of the works, laying of mains, and purchases of machinery, tools, etc. Upon the completion of these important preliminaries, the cost of material, supplies and labor will similarly be entered on the cash book.

The plant having been completed, the material being on hand, and the laborers ready to begin business, the auxiliary books—*i. e.*, those necessary in the varied details of the business, must now be brought into use.*

These books having been properly kept, the works in operation, the gas manufactured and distributed, and all the receipts and expenditures noted—at the end of six months or other desired period, by referring to these books, it will be found that they will reveal the component parts of profits earned, and also the losses sustained.

Making out the statement of profit and loss should be a very simple operation. First, the actual cash receipts from sales of gas, coke, tar, ammoniacal liquor, etc., and an estimate of the amount of gas delivered during the six months for which the cash has not yet been collected; the value of sold and unsold coke, tar, ammoniacal liquor made during the six months. This is contained on one side of the statement. The other side should contain the storage cost of coal distilled during the same period; the cost of repairs, including those to stack, benches, cost of labor of setting retorts, placing stand-pipes, mouthpieces, etc., wages, taxes, rents, and current expenses. Deducting one side from the other will show the profit and loss.

A very important matter to be determined in the conduct of the manufacture of the gas, is its cost, as well in the holder as of its distribution and the management.

In finding cost in holder, for any stated period, we should charge the amount of coal or oil used at its storage cost; the wages paid in carbonizing, purifying, etc.; the cost of purifying material; the fuel used; the repairs and renewal of stacks, benches and retorts; the salary of the engineer, or so much of his time as is devoted to the manufacturing; proportion of water and taxes. In fact, all charges up to the holder. From these charges must be deducted the value of the coke, tar, and ammoniacal liquor obtained, and of spent lime left for sale—if lime is used—during the same period.

In obtaining the cost of distribution, include all costs of repairs, etc., wages and proportion of salaries, from and including the holder, up to manager's department.

The cost of management would be, salaries, stationery, etc., incident to the collections and general business.

The cost of gas must of necessity greatly vary in different localities, as the prices of material and labor obtained therein. It has been the practice of some to ask and expect those companies, far away from the coal mines, and where labor is comparatively high, to manufacture and sell gas at as low rates as those corporations who are located at the very mouth of the mines, and where labor does not command so high a price; and it is a sad commentary upon the intelligence of the age, to note the effort of municipal legislators to determine the price of gas by statute. Why this is the only one manufactured article singled out for this purpose, it is difficult to understand. Would it not be more just to go further back—behind this point—and fix by statute the prices of the material the manufactures are obliged to use and the labor to employ?

*Discussion.*

The Chairman—You have heard a very interesting paper, and I think the Secretary has made a good selection in having it follow the one just read—"The Engineer and his Pencil." Here we have the "Secretary and his Pen." The paper is open for discussion.

Mr. Shelton—I think this is a most important subject. There is evidently a necessity for keeping pen records as well as pencil records. I note that Mr. Ramsdell has just come in, and as I believe that he is on the Committee of the Western Association with regard to securing uniformity in gas accounts, I suggest that he might have something to say on this subject.

Mr. Ramsdell—I was called from the room, and so did not hear all of the paper which was read by Mr. Fodell; but I was very much interested in what I did hear. I think this is one of the most important subjects to come before our Association. From my study of the subject when getting up the report for the Western Association I found there was a great want of uniformity of system in keeping the accounts of gas companies, most companies having systems of their own. If I should have to write that report again I would change it a little from what it was as made. Having experimented a little since then, the change I would make would be in the distribution of the fixed charges. If you study it I think you will find it is quite a knotty problem, and one that requires a great deal of study to solve it satisfactorily, so as to suit the various kinds of work and the various modes of manufacture. Mr. Fodell makes one change, and that is in the item of depreciation, which, in my report, was recommended to be treated as a fixed charge. Mr. Fodell's explanation of it as given in his paper would seem to cover exactly the same grounds; for he suggests the idea of laying aside for a number of years a fund which in time would be sufficient to re-erect the works. This would be the same practically as the plan which the Committee recommended in their report.

Mr. Littlehales—One item in reference to that has often appealed to me. It will be a great advantage to every member of this Association if it were practicable (as possibly it might not be) to follow the precedent set on the other side of the water. Often we fail to get as good results as we might by not knowing what our friends are doing. As you know, all the British companies publish the details of what they are doing. Probably that would not do for this country. If a scheme could be devised in any way by means of which we could each know the details of the other's working—classified and analyzed—it would be of immense advantage to us. I do not know whether that is practicable. I may say that I have for years past, in the companies I have been connected with, kept such a detailed record—taking the leading items for our balance sheet, and dividing them by the number of tons of coal used, so as to show each item of cost per 1,000 feet of gas made, and per 1,000 feet sold. I take the income and the capital, and divide them in the same way. It would be of great advantage to every one of us if some such system could be adopted. I do not know whether the feeling of the members would be in favor of publishing their accounts in that shape; but any member of the Association is welcome to see my accounts.

On motion of Mr. McIlhenny a vote of thanks was tendered to Mr. Fodell.

At this point the President resumed the chair and said—While Mr. Adams' paper is being distributed I desire to refer again to the report of the Committee on the President's Address. At the time the vote was taken on the adoption of that report another member was entitled to the floor or I would have made my remark at that time. I want to say that, in my opinion, the Committee, out of some very common material, erected a pretty handsome edifice. I owe them my sincere thanks for the compliment paid me in recommending the adoption of the various suggestions which I made. I feel greatly complimented also because the Association adopted these suggestions. I think the Association really ought, and doubtless does, give the members of that Committee their thanks for the interest they manifested, and for the work they did in connection with that report.

Mr. H. C. Adams, of Philadelphia, Pa., here read his paper on

## THE GAS COALS OF THE UNITED STATES—THEIR GEOGRAPHICAL AND GEOLOGICAL LOCATION AND AREA, AND THEIR PHYSICAL CHARACTERISTICS.

In the contemplation of the subject of Gas Coals and their use, we are struck with the beautiful example they present of the conservation of energy. The sunbeams of thousands upon thousands of years ago, hidden in this form in the bowels of the earth, were apparently lost forever. But the wise Architect of the Universe does not waste material; and Nature, His handmaiden, though seemingly prodigal, ever works with careful economy of her forces to the desired end. So, after a lapse of ages of a duration almost incomprehensible to our minds, we find the energy and material absorbed in the formation of these coals, given out again by the hand of man in the form of light and heat at the present day. Surely this is a monument to design in the planning of the creation; a mark of wise forethought in an omniscient Providence, to whom, when these coals were formed, their use in future ages was part of the stupendous but symmetrical plan that built our world.

Is there not much food for thought in that light that makes bright our nights in the long buried but now regenerated sunbeam, that centuries ago fell apparently wasted upon the world? And if we incline to philosophize further upon the subject, may we not find that the bright col-

*For forms of these books, see the little book published by A. M. Callender & Co., for me.

ors, imprisoned deep in this black mass of coal, do, when released, cause the flowers of the infant world to bloom again?

To turn now to the practical aspect of the matter before us, we find that a gas coal is technically and commercially known as one having, say, 30 per cent. of volatile matter, not over 1 per cent. of sulphur, and a low percentage of ash. But, as a matter of fact, the percentage of volatile matter is not so much the criterion as is the quality. For, as we shall find, a coal lower in volatile matter than another, may yet yield a greater quantity of richer gas, and be unqualifiedly superior for gasification. So while low percentages of sulphur and ash are essential prerequisites of a good gas coal, the volatile matter is qualified by the question of quality. In a country like our own, where so many different grades of coal are used in gas making, it is difficult to precisely define a gas coal, save to say that it is such a coal as may be practically used in gasification in the production of illuminating gas. It must have, of course, a certain percentage of volatile matter charged with illuminating hydrocarbons. We may, perhaps, safely draw the line at or about 60 candle feet, and say that no coal is used in this country in gas making that yields much less than that quantity and quality.

The essentials of a good gas coal are a low percentage of ash, say 5 per cent.; and of sulphur, say ½ of 1 per cent.; a generous share, say 37 to 40 per cent., of volatile matter, charged with rich illuminating hydrocarbons. And it should yield, under present retort practice, 85 candle feet to the pound carbonized. It should also be sufficiently dense to bear transportation well, so that when carried long distances, it may not arrive at its destination largely reduced to slack or fine coal of the consistency of sand. And it should possess coking qualities that will bring from the retorts, after carbonization, about 60 per cent. of clean, strong, bright coke.

Our theme is readily divisible into two principal parts. The first of which, and the one to which we shall confine our attention in this paper, relates to the geographical and geological location and area of the gas coal deposits and their physical characteristics. The second part has to do with the relative commercial values of the different coals, and their behavior and results in gasification, and is beyond the scope of our present inquiries.

In considering, then, the geological, geographical, and physical aspects of the coals, we must begin at the beginning, and take our way with hasty footsteps along the pathway of creation, until we reach the carboniferous jungles that were the source and origin of our subject. Starting with the nebular hypothesis, for want of a better one, and gazing upon our world, a globe of gaseous matter suspended by the laws of gravity in mid-space, we see it cooling, solidifying, and shrinking, until we have a molten mass enveloped with a hardening, cooling, wrinkling crust. Then comes the precipitation of great masses of vapor, and the appearance of a universal ocean reigning supreme. Through this the tightening crust thrusts its wrinkled granite head, and we have the foundation of our continent. Against these attacks upon its supremacy Old Ocean fiercely fought, and dragged out into its depth great quantities of sedimentary matter, which, thickening as time passed on, placed the first story upon the house of our habitation. So went on through countless years the building of the world, until at last a great area of dry land in the northern part of our continent was raised by one of the volcanic throes that characterized this period. Upon this broad area, covering our Northern and Middle, and part of our Southern States, now ripe for planting, were sown by the Creative Hand the seeds of vegetation that burst forth with incredible luxuriance, and flourished and increased with wonderful prolificacy. Swamps and jungles grew, and fell rotting upon the ground, to be succeeded by others equally productive, and these again returned to earth to make way for their successors. Thus a great depth of vegetable matter was deposited; how great we may perhaps imagine, when we consider that it has been estimated that 1,200 years' growth of the most luxuriant vegetation of to-day would furnished the material for a coal seam of a thickness of only 6 inches.

Now, a sudden subsidence of the continent occurred, and over these vegetable deposits the ocean rolled, carrying with it and piling upon them masses of sand and mud which pressed heavily upon the underlying stratum of vegetation, and gradually but surely, in the slow process of Nature, changed it into coal. The sand and mud in their turn become the superincumbent rocks, and we find we have proceeded one step in the formation of the coal measures.

Then another upheaval took place; again vegetation flourished. Again the giant ferns, clubmosses, and reeds spread out their leaves and branches. Then came another sinking of the land, another reign of Old Ocean. Again are the vegetable masses crushed under thousands of tons of sand and mud, and solidified, preserve to us in the form of coal the carbon that in the form of carbonic acid their greedy lungs had sucked from the atmosphere of those days. So, with like repeated processes, vein upon vein of coal is formed and the coal measures completed. Not, however, in their present area or condition, for subsequently glacier and flood wrought sad havoc in these fields, and the upheavals and disturbances of the unsettled earth crust distorted and displaced them. But here we see again the hand of a foreseeing, provident Architect. Had not these glacial, aqueous, and volcanic disturbances displaced these measures, had they not been cut into or lifted up, had they lain in their original planes, they would have been forever buried beyond man's reach and knowledge.

The conditions we have just described characterized what has been aptly termed the Carboniferous period; and it forms, with two small exceptions, the sole source of our coal deposits in our Eastern, Southern, and Middle States. Subsequent like condititions at a later period, the Triassic, but upon a small scale, led to small deposits of coal in Virginia and in North Carolina, but they are of such restricted areas as to be of only local importance.

Upon a more extensive plan, however, were the deposits of a still later age, known as the Cretaceous, in which were formed the extensive but generally inferior coal fields of the western part of the United States.

The relative ages of these coal fields are determined by the fossils contained in the measures, which form ready and sure indices. The original deposits were probably all of a bituminous character, varying in kind according to the various conditions of pressure and locality. The difference in the quality of the volatile portion is probably due to the different kinds of vegetation that entered into the composition of the coals in different regions. The physical treatment, of course, had much to do with changing the character of coals formed from identical kinds of vegetation. Beginning with peat, the first and lowest form of bituminized vegetation, and passing on through the bituminous, semi-bituminous, and anthracites, we find that the laboratory of Nature formed them successfully, according to the conditions imposed upon them. An original bituminous deposit subjected to the heat and disturbance of volcanic action, has its volatile matter slowly distilled off, and there remains the carbon or anthracite. The degree and duration of heat in distillation regulate the quantity of volatile matter left in the original coal, and stamp its character as bituminous, semi-bituminous, semi anthracite, or anthracite, or proceeding one step further, graphite.

Cannel coal is supposed to be the product of masses of finely macerated vegetable matter, collected in the form of carbonaceous mud, in lagoons or small lakes. This would account for its compact and homogeneous structure, and for the fact that it is generally found in small "pockets" of limited area. And it would account also for its retention of a high percentage of the original volatile matter contained in the plants, and for the high percentage of ash.

Now, taking a bird's-eye view of the United States, the area under discussion, we see first a long deposit of coal stretching down from New York to Alabama, almost parallel with the sea coast. This is the great Appalachian field, the original and principal one. It lies in Pennsylvania, Ohio, Virginia, West Virginia, Kentucky, Tennessee, and crossing the northwestern corner of Georgia, terminates in the northern part of Alabama.

Next we find the middle coal field, lying principally in Illinois, but extending eastward into Indiana, and southward into Western Kentucky.

Then comes the western field of Missouri, Iowa, Nebraska, Kansas, Arkansas, and Indian Territory. Finally, we see the great cretaceous deposits of the Western States and Territories, whose areas and values have not yet been fully and accurately determined, but which are rich in promise. Through these fields we shall take our way in search of gas coals.

Starting in Pennsylvania, on the Atlantic seaboard, we shall pass southward to the Gulf, and thence again north and westward to the Pacific.

At the outset we must halt for some time in Pennsylvania. The importance of her deposits merits more lengthy consideration at our hands than do those of any other State, for from her coal beds are drawn the principal gas coal supplies of the Middle and New England States; and the West, the South, and Southwest likewise look here in some measure for their supply.

Pre-eminent as a coal producer among all the States stands Pennsylvania, whether we regard her vast anthracite formations, peculiar to her own confines, or her vast area of semi-bituminous steam coals; her great bed of world renowned coking coal, of her magnificent area of standard gas coal. She sent out to the markets of the country in the year 1889 one-half of all the coal shipped over the wide area of the United States; and the next most active of her sister States, Illinois, sent out only one-fifth as much. Blessed as she is with all these various

grades of coal, in none of them is she more fortunate than in her gas coal, having regard to quality, quantity, and accessibility, the three prime essentials. In speaking of gas coal, we need consider only, at present, that pre-eminent bed lying in the southwestern corner of the State, adjacent to the city of Pittsburgh, from which it derives its name—and which in area, uniformity, and quality is not approached in the coal fields of the world. It is spread over the five southwesternmost counties, and exposed to commercial operation in profusion in all directions by the erosion of the many and noble streams that flow through it. The Allegheny river to the north, the Youghiogheny and Monongahela to the south, joining at Pittsburgh to form the mighty Ohio, are lined with coal mines along their banks, and expose long lines of virgin coal in the more remote regions, awaiting the expansion of the coal production that will necessitate their development. It seems as though such magnificent water ways had been made to order through this region, so manifold and so serviceable are they. These streams are wide and shallow, and Nature has to be assisted somewhat to render them navigable with any degree of regularity. Hence, great dams have been built across them to back up the water and give a floating depth to the coal-laden barges and the steamers that tow them. These dams have been built at varying distances along the Monongahela, from Pittsburgh clear up to the Pennsylvania State line. There formerly were some in the Youghiogheny river, to furnish slack-water navigation there; but the fierce competition in the river coal trade, combined with the extension and competition of railroads, have forced them into disuse, and they have fallen to decay. Owing to the natural navigability of the Allegheny, no dams have ever been erected in its waters.

As a basis for the slack-water navigation of its tributary rivers, an immense dam was built at Davids Island, on the Ohio, a short distance below Pittsburgh. This provides for water up to the first dam of the Monongahela, opposite the city of Pittsburgh. Other dams at varying distances, to the number of seven in all, reach to within a few miles of the West Virginia line. The second dam is located 10 miles above the first, near the town of Braddock. The third dam is just below the town of Elizabeth, 12 miles or more above the second. The locations of these dams have been described thus minutely, because they have been used to define to a certain degree the limits of the best gas coal. The slack-water area between the different dams is known as a "pool"; thus the water between the first and second dam is known as the first pool; and the water between the second and third dam, or say, between Braddock and Elizabeth, is known as "second pool." In the latter term a well-known and generally used trade name will be recognized, designating the best grade of gas coal. This has come about, because the slack water above the second dam, extending down the Youghiogheny as well as the Monongahela river, lies in the belt of best gas coal, although it by no means defines its limits, but serves as a general indication of the quality required.

When the coal for river shipment is brought out of the mines in the pit wagons, it is run out into a dumping house or "tipple," as it is called in these regions. It is then "dumped" over separating screens into long shallow barges waiting in the river below. Some of these barges will be filled with screenings, others with lump coal, etc., etc. The barges hold about 500 tons, or 12,000 bushels each. These are then gathered into a "tow," representing sometimes 10,000 to 20,000 tons, 2 or 3 acres of coal, and placed in front of one of the river steamers, long, shallow craft, with a great stern-wheel, and pushed down the river, along the Ohio and Mississippi to the Southern markets, where the coal is sometimes held in large quantities and for a long time in storage, awaiting a rise in the market when coal becomes scarce through a "shut down" in the river workings, owing to the low stage of water, or from other causes. So much for the the water ways.

In facilities for transportation by railroad, certainly this region is unapproached. Each of the great valleys that form the principal sources of coal supply has a railroad on each side of it. For the Eastern market the great trunk lines, Pennsylvania Railroad and the Baltimore & Ohio Railroad, are the carriers. For the Western, the Baltimore & Ohio, the Pennsylvania Company lines, and the Pittsburgh & Lake Erie, with its connections, take the bulk of the tonnage. While northward to the lakes all those lines, with others of lesser importance, carry the immense tonnage shipped annually from Cleveland and other ports. Branch roads are run from the main lines of the roads along all the valleys that are productive of coal, and in most of these it lies cropping along the lines of railroads, so as to admit of the easiest and cheapest loading. The operations are rare where the distance from the mine mouth to the railroad car is over a few hundred feet, and it is generally much less than that. The coal, when brought from the mines, is run into the dumping houses, or "tipples," and "dumped" over the screens into the cars. That which passes over the uppermost screen, the bars of which are generally 1½ inches apart, is known as the lump coal; that which passes over the next lower screen, generally of bars three-quarters of an inch apart, is known as the nut coal; while the final small residuum is is known as the "slack" of the coal.

Thanks to the magnificent work of her State Geological Surveys, the gas coal region of Pennsylvania may be readily defined and described. The measures that confine it belong to the Carboniferous period of the Paleozic Age. The strata trend in an almost due northeasterly and southwesterly direction, slowly sinking into the earth as they pass to the southwest. Over their northeastern exposure, or crop, the plane of erosion has passed with glacier or flood, cut down the overlapping measures, and exposed the seems of coal to commercial operations, discovering them in their successive geological order. If these measures had been left in their original horizontal planes, the gas coals would have been sunk half a mile below the surface, and would have been immensely more expensive to reach and remove.

These carboniferous measures, some 2,600 feet thick, comprise within them all the coal beds, both gas and steam, of Western Pennsylvania. They have been seperated by the Pennsylvania Geological Surveys into four divisions:

1. The Upper Barren, say 1,100 feet thick, containing several inconsiderable seams of coal, fit only for steam or manufacturing purposes.

2. Upper Productive, say 500 feet thick, containing 2 or 3 small beds of only local importance as steam coal, and having at their bottom the famous Pittsburgh coal bed.

3. The Lower Barren measures, say 600 feet thick, from the Pittsburgh bed to the Mahoning sandstone—that useful geological landmark—and containing no workable coal beds.

4. The Lower Productive measures, say 450 feet thick, containing the Freeport and Kittaning coal beds, which in other parts of the State appear to a limited extent as gas coals, but are of great importance and value as steam coals, where they are more readily accessible and not contiguous to the superior Pittsburgh seam. In the upper series of these coals are frequently deposits of amorphous cannels; of small value, however, for gas making, owing to their large per cent. of ash and sulphur.

At the base of all these measures lies the well-known Pottsville conglomerate, below which there is no coal to be found, excepting a few small and unimportant seams in the sub carboniferous measures. But some 2,000 feet below the coal measures here lie the famous gas "sands." *i. e.*, sandstones, running from a pebbly conglomerate to a fine, porous sandstone, in whose pores and interstices are confined the natural gas and oil that need only the tap of the drill to bring them rushing to the surface of the earth. We have seen that as we descend into the depths of the earth we find only one considerable vein of gas coal in this locality, and that, the Pittsburgh, to which we shall now confine our attention. That seam, which erosion has placed within working reach only in Westmoreland, Washington, Greene, Allegheny, and Fayette counties, in fact, in the southwestern corner of the State, lies in successive shallow basins, with fairly well defined summits, *i. e.*, anticlinals, and troughs, *i. e.*, syclinals, to use the technical but now familiar names; these basins all have the northeast and southwest trend, with a gentle southwesterly dip. The dip or incline of the coal in the several parallel basins is generally gentle from trough to summit, though, owing to the narrowness of the basin, or to some irregularity in formation, it sometimes rises steeply up the sides. This comparative regularity of dip and trend is of great value in mining, and careful regard must be had for it. The economy of placing a shaft at the bottom of a basin, where it may draw upon coal with the aid of gravity from nearly three-quarters the area of a circumscribed circle, does not need lengthy demonstration. The coal bed has been nearly completely eroded from northern Allegheny county, while in the eastern part it is left only in isolated patches. In Westmoreland county it runs from a solid body, on the southern part, out to torn and ragged horns projecting out to the Conemaugh river, its northern boundary, where we can see how the anticlinals, or uplifted ridges, have been swept bare of coal, leaving it in the sunken troughs of the synclinals. Fayette County, too, has suffered from this erosion, but the vein lies solid and undisturbed in Washington and Greene counties, where it is deep beneath the sheltering cover of the superincumbent measures.

Now of this famous and magnificent vein, *facile princeps* among similar deposits, only a part is gas coal, properly called. As it passes to the eastward it becomes the famous coking coal of the the Connellsville region, and to the southeast, the famous Cumberland steam coal of Maryland. The change in quality is gradual, but may be fairly well defined.

Roughly speaking, there is no gas coal in this seam in Pennsylvania

west of Pittsburg. As the vein passes to the westward of that point the per cent. of volatile matter decreases and the structure of the coal changes somewhat, and becomes of a more dense character and what is known as a "block" rather than a gas coal—and the richer hydrocarbons seem to have been lost. Taking Pittsburgh, therefore, as a starting point, if we travel northeastward along the Allegheny river, to, say, Logan's Ferry, we shall have traced the northwestern limit. If we pass thence southeastward to the town of Salem, in Westmoreland County, we shall have drawn the line of the northern extension. Then if, leaving Salem, we trace an arc of a circle southwestward, with Pittsburgh as a center, from Salem to Lock No. 4, on the Monongahela river, we shall have the easternmost boundary; and if we return thence to Pittsburgh, diverging slightly to the westward of a direct line, we shall have determined the boundaries of the area of the gas coal. That, it may readily be imagined, it is a difficult and delicate task. The lines named, however, do practically define the limits as commercially recognized. There may, of course, be some good gas coal without those lines, and there is some bad gas coal within them. To the eastward of Pittsburgh there is no gas coal beyond the Irwin basin, of which the town of Irwin, Pa., defines the trough. Passing beyond that town, over the next crest to the trough of which the town of Greensburg is the center, we find the coal softer, having lost volatile matter, and fit only for steam coal. The sulphur, too, rises as we go on to the east. In the next, or Connellsville basin, the volatile matter has fallen to 30 per cent., and the seam thickened out to 10 or 11 feet, entirely changed in aspect.

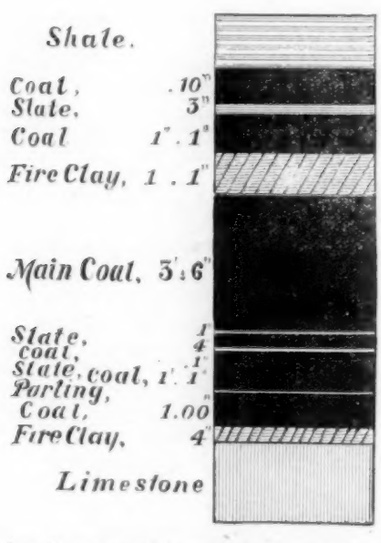
So, also, as we go southeastward up the Youghiogheny, and southward up the Monongahela, we find the coal thickening, the volatile matter lessening, and the sulphur increasing slightly; the coal gradually passing from a gas to a steam, and thence to the yet softer coking, coal. The thickening of the seam as we pass up the river is occasioned by the disappearance of the impurities in the way of slates, etc., in the steam, permitting to be mined there what is found unmerchantable in the gas coal region proper. This thicker coal is mined and sold for a fixed rate below the better coal lower down the river.

To the southwestward of Pittsburgh the coal changes in character, as described in speaking of the coal directly west of it, and becomes more of the nature of a block coal; and soon after crossing the Allegheny county line sinks below the upper measures, and becomes, literally and liberally speaking, beneath consideration.

The available Pittsburgh coal bed in its entirety in Pennsylvania is estimated to cover some 2,500 square miles—say 5,000,000,000 tons of steam and gas coals. In the region to which we have confined the gas coal proper, only a very small per cent. has been mined out. Over that whole area lies a vast body of virgin gas coal of the finest quality. Roughly, it may be estimated (allowing 50 per cent. for wastage, etc.) at 1,345,000,000 tons—sufficient to supply the whole United States, grow as it may, for centuries to come.

In the gas coal region proper the vein is capped by a heavy sandstone,

*Section.*




called the Pittsburgh, separated from the coal seam by only a thin seam of shale, which in some places disappears, leaving the sandstone resting upon the coal. The seam proper is divided into two divisions—the upper or roof division, and the lower division—the total thickness being from 9 to 10 feet. The roof division, being full of impurities in the way of sulphur and fine slate seams, is regarded as unmerchantable, and left intact, forming the roof of the rooms and entries of the mine. About one foot of fireclay, called "slate" by the miners, divides the two divisions, and this slate is always removed after mining away the coal beneath. It is responsible for more deaths in the gas coal mines than any other cause, for the reason that the work of mining beneath it works it loose from the roof coal; and while seemingly securely attached, a slight jar suffices to drop tons of it upon the heedless miner, and crushes him to death. In nearly every case, however, such an accident is directly the result of the miner's carelessness, born of the contempt for such menaces that long familiarity engenders.

The lower division of the seam, from which is cut the coal that is shipped to market, extends in a clean, solid mass from the "slate" just mentioned a distance of 3 feet 6 inches downward, constituting the "breast" of the coal, as it is called, and here is found the cleanest and best coal of the seam. Then two small 1-inch bands of slate occur, about 3 or 4 inches apart, that define the portion of the vein where the miner cuts in with his pick or his machine before he "breaks down" the coal, or loosens it from the overlying "slate." Below these slates again is a foot of good coal, which is taken up and shipped. Below that again, separated by a small slate parting, is a foot of bottom coal, as it is called, which, owing to its impurities, is left untouched in the mines. Below the seam is a fine four-inch band of fireclay resting on a shale or limestone. Thus, of a seam 9 feet to 10 feet in thickness, but 4 feet 6 inches to 5 feet is mined out.

This vein runs over the whole gas coal area with almost identity of structure, and with a wonderful persistence of form. Occasional breaks or faults occur in the form of clay veins, where, through some abrupt upheaval or rupture of the strata, the breaks in the seam become filled with a mass of clay or shale through infiltration from above. Again, where the strata has been crushed or jarred together upon itself, what is called a slack vein will occur, where for a time the otherwise dense coal of the seam will be of a loose, sandy nature. Horse backs or roof disturbances, and swamps, or temporary subsidence of the coal below its normal level, or the erosion or even total disappearance of it, likewise disturb at times the regular progress of mining work. Near these irregularities the coal frequently loses its normal form and character, and at times presents a tough, gnarled, splint-like appearance, and loses much of its value as a producer of gas.

Physically, the Pittsburgh gas coal is of the highest class of bituminous coals—*i. e.*, the richest in bitumen. In appearance it is black and shining with a resinous luster. It is compact, and of sufficient density to "stand up" well, and to submit to the rough usage of transportation without crumbling or being ground by attrition to fine, powdery coal. In fact, after an incredible amount of tumbling about in the course of shipment and reshipment, it retains the large lumpy form in which it leaves the mines.

It comes from the mines in large cubical blocks, or nearly of that form, caused by its rectangular cleavage planes. The main plane of cleavage is a vertical one, running regularly through the region nearly north, 25° east, showing a clean, shining, smooth, vertical plane of coal. This cleavage or "face," as it is called, determines the direction of the driving of entries into the coal, so that in the working places given the miner to cut the coal, rooms, as they are called, he may work against and along this cleavage plane, being thus aided in the extraction of the coal.

The horizontal fracture is conchoidal, and striated through the coal in horizontal plane is always more or less mineral charcoal, in thin seams, with a branch-like structure, showing clearly the woody, fibrous nature of the carbonized substance representing some vegetation that, for some reason or other, suffered more complete carbonization than the surrounding masses. While generally present in the coal, its bulk is inconsiderable. Thin seams of amorphous cannel appear occasionally running through the center of the vein. These, however, are of very limited area, and run from one to six inches in thickness, not sufficient to have any appreciable effect upon the average of the quality of the coal.

Occasionally small, white, scale-like deposits are found on the vertical faces of the coal. These are calcite or carbonate of lime, probably formed by percolation from superincumbent limestone. The quantity is, however, inconsiderable.

Now, in the matter of the discolorations so frequently noticed and so often complained of by gas engineers, they are generally of a nature that does not depreciate the coal in any respect for gas making, or, at the most, so minutely as to be incalculable. Sometimes there will be a

fine light-green or gray coating along the face, generally from coals mined below water level, which, however, is nothing more than silt or pulverized clay, which has found its way down from the superincumbent clays through the partings or cleavages of the coal. Again, through a slight efflorescence of sulphate of iron, a yellowish-white stain forms on the coal; but in this case, as in the others, the quantity is so small as not to affect the value of the coal at all.

But, however, when the coating becomes general and thick, and more particularly is of a rusty or reddish-yellow hue, it is almost always an indication that the coal has been mined near the outcrop, and is stained by the drainage of the surface waters through the coal carrying with them the clays or earth that stain the coal. In this case there is generally irridescence on the faces and on all the vertical fractures, caused by the percolation down the faces of thin films of oxide of iron, and the coal becomes rainbow-hued. Those coals mined near the surfaces are generally freer from sulphur than those mined further under cover, and higher in ash; but their worth as gas coals is considerably diminished, owing to a depreciation in the quantity and character of the yield of gas, due to the action of the continuous flow of the surface waters over them.

We now turn to the impurity of chief moment to the gas maker—*i. e.*, sulphur. Sulphur we must find, for sulphur in coal is like bark on a tree—it is always there, varying in quantity. It is principally present in combination with iron as iron bisulphide or iron pyrites. This occurs generally in thin brass-like flakes, hard and brittle, with a bright, metallic luster, and hence the name for it of "fool's gold." It is also present at times in large flat scales, and again in globular masses of the size and shape of the familiar cobble-stone. The thin flakes or scales are universally distributed through the bed of coal; but, fortunately, the larger stones are of comparatively rare occurrence, and generally lie in well-defined groups or beds. When such beds are met it is the best mining practice to drive through or around them, and not to attempt to extract the stones as they come to light, and then market the coal. These sulphur stones, when in appreciable quantity, almost always occur in the upper and lower portions of the "breast coal," within well-marked limits.

The percentage of sulphur in Pittsburgh gas coal varies from $\frac{4}{10}$ to $\frac{6}{10}$ of 1 per cent. It should average about $\frac{1}{2}$ of 1 per cent. in the long run. Experiments have shown that besides the sulphur in combination with iron as pyrites $Fe\,S_2$, there is a varying quantity of free sulphur present; probably about 40 per cent. in the Pittsburgh coal, though that per cent. is variable. Experiments did determine, however, that whether sulphur existed in the coal free or as $Fe\,S_2$, it made no difference in the per cent. volatilized in the process of coking or carbonization. It was found that about 40 per cent. of the sulphur was volatilized in carbonizing; leaving 60 per cent. in the coke. But that per cent. of sulphur is precisely the per cent. the residual coke bears to the coal. Thus we come to the important conclusion, verified by experimentation, that a coal high in per cent. of sulphur will yield a coke of like high per cent. A coal foul with sulphur, therefore, cannot make a clean coke.

When subjected to heat, the Pittsburgh coal cakes and swells; hence the name "caking," as applied to it and others exhibiting a like characteristic. The volatile matter of the coal making its way through this intumescing, fusing mass, leaves a series of pores and cells, composed of the carbon of the coal; and if, after the volatile matter is distilled off, the heat be withdrawn, the familiar porous, cellular mass of coke is found.

In analysis, the standard Pittsburgh gas coal will, on the average, determine as follows:

| | | |
|---|---|---|
| Volatile matter | 35 to 40 | per cent. |
| Carbon | 54 to 58 | " |
| Sulphur | $\frac{4}{10}$ of 1 | " |
| Ash | 3 to 5 | " |
| Water, at 225 | $1\frac{1}{10}$ | " |
| Per cent. coke | 60 | |

A glance over the above analysis suffices to show why this coal ranks as the standard gas coal of the United States; and why other coals are classed as good or bad, according to their approach to it. Here is represented the happy medium: no extraordinary yield of rich gas, with a tremendous evolution of sulphur; no high percentage of volatile matter loaded down with an overbalancing burden of worthless ash. The volatile matter yields a fair return; the coke is plenty, clean and merchantable; the sulphur within limits that admit of its ready and cheap elimination; the ash, representing the residuum of impurities, wonderfully low. In fact, if we must have sulphur and ash, as necessary evils, here they are to be found at a minimum.

The uniformity of structure and analysis over the immense area of this bed of coal is wonderful. The exhaustion of thousands of acres, the driving of tunnels or entries for miles, into and under the hills through the heart of the seam, bring to daylight and thence to market coal that is practically identical with that found at the beginning of operations.

This persistence of chemical and physical structure is of no small importance to gas companies. It enables them to predicate certain results in carbonization through a year's work or through a course of years. It gives them a constant as the base of their calculations, without which progress were impracticable. We need not fear comparison here with our English cousins. Their best gas coals average about the same as our standard coal in volatile matter. In ash they average better than we do, not running much over 2 to 2½ per cent.; but in sulphur, the far more important consideration, they average about double that of our standard coal. While as compared with the Provincial gas coals of this country, from the Cape Breton district, we stand decidedly superior, both in quantity and quality of gas; and also in freedom from sulphur, the Provincial coals containing nearly six times as much of the latter impurity; and finally, we excel in greater yield of a superior quality of coke.

The Pittsburgh gas coals first reached the seaboard markets in the early 50's. The coals from the Pennsylvania Railroad main line were the first brought forward. The Youghiogheny coals of the Baltimore and Ohio Railroads were considerably later, owing to the lack of necessary railroad facilities from that district, the railroad from Pittsburgh to Connellsville being then operated as a separate line.

When the first attempt was made to sell these Pittsburgh coals to the seaboard gas companies, it met with most decided opposition in the prejudice that existed in favor of Newcastle and Pictou coals. The gas engineers of those days could with difficulty be persuaded that any good gas coal could be found in the United States, and they were loath to try experiments with such unknown quantities. Finally, however, after long and persistent efforts on the part of those having in hand their sale, successive trials were made with these coals, with the never-failing result of their final adaptation as the principal raw material of carbonization. They promptly demonstrated their superiority over the Provincial coals, and their at least equality with the best of those from Newcastle. They became at once the recognized standard of gas coal, and their consumption has since kept equal pace with the growth of the gas business of the country. The use of these coals in the West and South, and generally in the interior of the country, has been cotemporaneous with the establishment and operation of gas companies, no other suitable material offering as a substitute or predecessor.

Leaving the famous Pittsburgh seam, we find only two other gas coal districts in Pennsylvania to command our attention. (1) The Reynoldsville region of Jefferson county, and (2) the Beaver river region of Beaver county.

In Jefferson county the lower Freeport vein of coal, which, in investigating the Pittsburgh seam, we found lying some hundreds of feet below it in the lower productive coal measures, rises both in position and quality, and is spread over the whole county, and of workable thickness wherever found; and while it is principally of the composition best fitting it for a steam coal, yet in certain localities it attains the dignity of a gas coal. This seam here lies in parallel troughs with the same northeast and southwest trend that we found in the Pittsburgh coal, and it is of best quality and principally mined in Winslow Township, on the eastern edge of the county, in the basin or trough in the center of which the town of Reynoldsville lies, and to which it gives its name. The coal from this region reaches the markets of the North and Northeast, where it is principally consumed, by way of the Buffalo, Rochester and Pittsburgh Railway and the Western New York and Pennsylvania Railroad. Owing, however, to the incursions of the superior Pittsburgh coal at low prices over competitive routes, the use of this Reynoldsville coal for the manufacture of illuminating gas has practically ceased. Its gas making properties, however, fully justify its consideration here among the gas coals of Pennsylvania. As a steam coal, it is mined and shipped in large and constantly increasing quantities, and it is from this region that the Northern and Northeastern markets principally depend for their steam coal supply. In physical appearance, the coal is bright and lustrous and compact; but it has not so deep a resinous luster as the Pittsburgh, nor is it so dense. Hence, from its greater friability, it does not stand transhipment so well. It has numerous charcoal partings throughout, and is quite pyritous. The total thickness of the vein here is some 15 feet, but the upper part of it is composed of successive thin strata of coal and fireclay, and only the bottom member, 5 to 6 feet in thickness, contains merchantable coal.

A fair average analysis of the best of this coal is :

| | |
|---|---|
| Water, at 225 | 1.12 per cent. |
| Volatile matter | 33.00 to 35.00 per cent. |
| Carbon | 60.00 to 59.00 " |
| Sulphur | 1.27 to 1.43 " |
| Ash | 3.00 to 5.00 " |

The Beaver county region owes its existence to the presence along the valleys of its rivers, at accessible points, and in workable quantities and merchantable quality, of the Darlington or Upper Kittaning seam of coal, another of the veins of the Lower Productive measures lifted into prominence through the rise in the measures, and the absence of the Pittsburgh coal. This Kittaning seam is very irregular in thickness and character through Beaver county. On the average, however, it runs from 2 to 3 feet thick, not of a dimension to recommend it to extensive development, as thin seams of coal are necessarily troublesome and expensive to mine.

At Darlington, in Beaver county, it attains a wonderful thickness, and carries with it a thick vein of cannel, a purely local deposit, however. The seam here is at times some 20 feet in thickness. At the bottom is a small bituminous seam 1½ feet thick, then comes 6 to 12 feet of cannel, and above that again some 6 feet of cannel, gradually passing into a cannel like shale. Sometimes so much as 12 feet of good cannel have been taken from this deposit, but the average is about 6. The area of the gas coal is found in Darlington and Beaver Townships, in Beaver county, and up along the Big Beaver Valley in Lawrence county. The coal here, however, has met the same fate as that of Jefferson county. The advent of the cheap and superior Pittsburgh coal has ousted it from any market as a coal for the manufacture of illuminating gas. The cannel, of course, continues so to be used ; but it, too, suffers from the competition of the superior Southern cannels.

The cannel is of conchoidal fracture, compact, with dull, lusterless appearance. It analyzes :

| | |
|---|---|
| Water | 1.160 |
| Volatile matter | 48.015 |
| Carbon | 38.241 |
| Sulphur | .599 |
| Ash | 11.985 |

a very repectable showing.

The gas coal of this bed is compact, bright, with clear, resinous luster; in places it is remarkably pure, though generally high in sulphur. An average analysis is :

| | |
|---|---|
| Water, at 225 | 1.78 |
| Volatile matter | 40.00 |
| Carbon | 49.00 |
| Sulphur | 3.00 |
| Ash | 4.06 |

In West Virginia we find the remaining two of the three principal gas coal regions of this country. In the northeastern part of the State lies the "West Virginia Gas Coal" region, as it is commercially known, and in the southwest lies the great Kanawha field. This State is blessed above all of her sister States, with few exceptions, in the richness and extent of her mineral deposits. Steam, gas splint, and cannel coals all abound within her borders. On every side is coal of one or another quality to be found. Of the 54 counties in the State, only 6 lack workable coal beds.

The coal measures of West Virginia are of the same general system as those described in Pennsylvania, of which they are an extension. In the northern part of the State we find the Pittsburgh bed, and in the southern part, the lower measures furnish the various seams. So far as gas coal is concerned, we may make two great divisions : (1) the West Virginia region, lying in the Monongahela Valley ; (2) the Kanawha region, lying in the valley of the great Kanawha. To the first of these we will now turn our attention. The same river, the Monongahela, almost synonymous with coal, along whose banks, in Pennsylvania, we found gas coal lying in such abundance, crossing the Pennsylvania State line, flows southward, forking out to the southeast and southwest, through the northeastern part of West Virginia, and cutting down through the superimposed strata, exposes the Pittsburgh seam again along its course through Monongahela, Marion, Taylor, and Harrison counties, and defines the gas coal region. Through this broad valley runs the Baltimore and Ohio Railroad, the outlet of this region to the various markets, East and West. To the eastward the coals pass along the Baltimore and Ohio rails to Baltimore, where they are transhipped into vessels and carried to the gas companies of the Atlantic seaboard, and in this direction the greater part of the tonnage is carried. Outlet is had to the Northwest and to the Lakes at Cleveland by way of Wheeling ; and to the West and South by way of Parkersburg branch to the Ohio river. Grafton, in Taylor county, represents the railroad center of the region, and from that radiate the various branches of the Baltimore and Ohio, carrying the coals to the markets above described. These coals appeared in the markets early in the history of gas making in this country, and were among the first United States coals carbonized. In the early 50's the shipment of them to New York, Philadelphia, Boston, and Baltimore was begun, and in spite of the competition of other and more newly developed regions, it is still maintained. Owing to the fact that many of the operators coke their screenings, large-sized screens are found among these mines ; in fact, they run from ¾-inch to 3-inch apertures. This should make the proper cleaning of the coal an easy matter, and more than compensate for the lesser density of the coal and their greater liability to loss from attrition than the Pennsylvania coals in being carried to market.

The Pittsburgh seam, which underlies the whole northwestern half of the State, and which is found again in the easternmost countries and across the Maryland State line as the famous big vein Cumberland coal, is the sole source of gas coal in the West Virginia region. While it is mined along the Ohio river on the western border of the State, and in other parts, it is nowhere of the sufficiently strongly marked "gas" character as in this district. We may name Monongalia, Preston, Taylor, Harrison, and Marion counties as defining the gas coal area. There are no gas coal operations east of Newburg, which lies close to the eastern crop of the seam, nor west of Wilsonsburg, beyond which point the vein sinks, to rise again as it approaches the Ohio river. The coal measures here lie in the parallel northeast and southwest basins which we found characteristic of the Pennsylvania coal measures. The light dip of the coal in the wide basins and the general parallelism of the strata render mining easy. The coal is everywhere within easy reach in the Monongahela Valley. At Newburg, on the east, it is found in the hill-tops ; at Fairmount and Gaston it has fallen to the level of the railroad. So accessible is it that there is only one shaft in the entire district. Fairmount, in Marion county, may fairly represent the center of this region. As we go thence down the Monongahela we find the quality of the coal deteriorating, and becoming more impure and sulphurous. Following the valley to the south, below Clarksburg, we find the seam thinning out, and the coal falling in value. At Clarksburg and Fairmount, and between those two points, the coal is a magnificent seam, running from 8 to 10 feet of clean coal. The entire section of the seam here is 15 feet. The first 4 feet compose an intermixed shale coal and slate roof division ; then comes the main bench, say 9 feet of good, clean coal ; then, below a small, 3-inch parting, comes an 18-inch bottom bench of poor, slaty coal. The whole 9 feet of coal is taken out, being undercut at the bottom. Such a splendid breast of coal should afford an opportunity for bringing out coal in first-class condition, with little labor and expense. This main bench of coal is generally clean and free from slates, though they occasionally occur near the top. In density the coal is nearly equal to the Pittsburgh coals of Pennsylvania. It has a clear, sharp, cubical cleavage and conchoidal fracture. The cleavage, at times, however, is seen as slaty or splink-like, bringing out the coal in long slabs, instead of the familiar cubes. The lustre of the coal is bright and resinous. It has, in fact, the same general characteristics as the Pennsylvania coals. Through its lesser density it does not bear transportation so well, and has a tendency to slack in rehandling and transhipment, which of course, reduces its value for gasification at that point of delivery. It is, further, highly pyritous, and, in fact, the chief inferiority of this coal to the Pennsylvania coal is in its greater sulphurousness. All through the region it is impregnated with this impurity, which runs extremly high towards the limits of the gas coal area, and which really, to a large extent, defines it.

The two mining centers are Fairmount, in Marion county, and Clarksburg, in Harrison county, and around these two towns are grouped the principal mines of the district. While the general characteristics of the coals in these two districts are the same, yet generally speaking, the coal near Clarksburg is likely to be more sulphurous than that around Fairmont. Locally, the coals of the West Virginia region vary so, that it is difficult to give a general statement as to their chemical composition. An average of a large number of analyses of the standard coals gives the following approximate determination :

| | |
|---|---|
| Volatile matter | 35 to 40 per cent. |
| Fixed carbon | 53 to 57 per cent. |
| Sulphur | 1 per cent. |
| Ash | 4 to 7 per cent. |

In gasification, this coal, owing to its high percentage of sulphur, is rarely used "straight" ; but generally in a mixture with other less sulphurous coals.

No mention of the gas coal districts of West Virginia would be complete without mention of the once famous Ritchie mineral, a species of asphalt that was found in a vein 4½ feet thick, vertically, extending over a small area in Ritchie county. This pocket, as such small isolated deposits are generally called, was soon exhausted, and the supply ceased.

The deposit closely resembled the Albertite of the Province of New Brunswick, and, like it, proved of great value as an enricher of coal gas. It analyzed 55 per cent of volatile matter, 42 per cent. of carbon, and only 3 per cent. of ash. It gave 26 to 28 bushels of fair coke to the ton carbonized—a favorable comparison with the best cannels of to-day.

Passing on southwestward we come into the great coal-field of the Kanawha Valley. The containing measures here are the equivalents of the Lower Productive, *i. e.*, the Freeport and Kittaning, veins of the Pennsylvania series, and are of great thickness and commercial value.

The Pittsburgh seam, which has heretofore furnished the principal field for our inquiries, does not enter to any considerable extent the field of the Kanawha Valley operations. Its outcrop or limit passes southwestward through almost the centre of the State, strikes the Kanawha River near the western boundary line of Kanawha county, passes on down into Campbell county, and turns thence northwestward into Ohio. And, while it is worked at points along the Kanawha River between Kanawha county and its junction with the Ohio, yet it is so small a factor comparatively with the enormous developments in the lower measures further up the river, that it deserves mention only as defining the southernmost limit of that famous seam.

The Kanawha River, which defines the important region to which it gives its name, has its head waters in North Carolina, thence they flow northward across the western half of the State of Virginia, and entering West Virginia near the point where Mercer, Summers and Monroe counties join on the State line, flow northwestward, across the southern half of the State, to Point Pleasant, where they meet the Ohio River.

The Kanawha proper extends only from the Ohio to its junction with the Gauley River, near Kanawha Falls. Above that, it is known as the New River. The river system has been described above at length, because it so clearly marks the scene of operations in the coals, and, roughly speaking, its divisions likewise divide the grades of coal for our purposes.

The New and Kanawha rivers have really no valleys, in the sense of broad areas of level country, contiguous to their course. They run in a deep and narrow cañon, which they have worn down through the Lower Productive measures, exposing the various coal seams at successive levels along their precipitous banks. We find here the same characteristic that held of the Pittsburgh seam, in our researches through its course to the northeast of this region, *i. e.*, the gas coals on the west, and the steam and coking coals on the eastern side of the field. Along the New River lie the great fields of steam coals to which that stream has given name; while on the Kanawha proper, from Kanawha Falls to Charlestown, and extending, say, 30 miles north and south of the river, we find the gas-coal region, or the area of the best gas coals. From Kanawha Falls, westward, these veins lie above water level; but near Charlestown, as they approach the Pittsburg seam, they sink, and pass below water level, and out of the reach of commercial operations.

There are exposed in that district 4 or 5 seams of coal along the river bank. The lower one lying, to take a typical section, some 20 feet above the river level, and containing 4 feet to 4 feet six inches of good bituminous coal. Then next above, perhaps 100 feet above, comes the second seam, 6 feet 7 inches thick, containing the gas coal. Further on, at 500 or 600 feet elevation, is found a vein of splint coal, about 100 feet above which, in a splint seam some 6 feet thick, comes in the famous cannel of this region. And capping all, about 800 feet above the river, is found a seam of some 6 feet block coal. Thus, taking a fair example of the river bank, we see an extraordinary exhibit of seam upon seam of coals of different but all of good quality, exposed at accessible points, and all of workable thickness.

The moderate dip of the measures to the northwest, 40 to 60 feet to the mile, permits of easy and cheap mining. The coal when brought out is lowered to the river on inclined planes, and there "tippled" into boats or cars, as may be desired. The gas-coal seam, which is known as seam No. 2, runs from 4 to 7 feet in thickness, made of 3 benches with clay partings, and with seams of splint, 4 to 14 inches thick, interstratified. The coal itself is clean, with a clear black, resinous lustre, of cubical cleavage and conchoidal fracture. Its density is not quite so great as that of the Pennsylvania gas coals, and it consequently suffers more than they do from the attrition of transhipment. Its general preparation for market is the same as that of Pennsylvania coals, save that it is screened over one and one-half inch screen to increase its lumpiness. It is also more highly sulphurous; but with those two exceptions it is quite the peer of the Pittsburgh coal, giving a large yield of high-candle gas, and having a very low percentage of ash. This region possesses very valuable facilities for shipment to the markets of the East, West and South. The United States Government has built a very extensive and complete system of free slack-water navigation on the Kanawha, similar to that described in the Monongahela. And by means of it the Kanawha coals are shipped by water at very low rates to points along the Ohio and Mississippi valleys, where they have become very large and dangerous competitors of the Pittsburg shippers. The only rail carrier of these coals from the mines is the Chesapeake & Ohio Railroad, which takes them to the markets of the West and Northwest by way of Point Pleasant. To the Eastern market they are carried by rail to Newport News; where extensive shipping piers are erected, and shipped thence by vessels to the various gas companies of the Atlantic seaboard, where they are no inconsiderable factor in the gas-coal market, which they first entered about the year 1876. They are, however, owing to their general high percentage of sulphur, compared with the Pennsylvania coals, for the most part used in admixture with the latter, and only in a few instances are they carbonized "straight."

Analyses of the product of some of the various gas-coal mines in this region determines:

| | | | | | |
|---|---|---|---|---|---|
| Volatile matter . . | 35.1 | 40.42 | 34.91 | 33.92 | 37.357 |
| Carbon . . . . . | 64.9 | 56 | 61.75 | 61.96 | 56.257 |
| Sulphur . . . . . | 1.48 | (not given) | (not given) | .65 | 1.286 |
| Ash . . . . . | 2 | 3 | 2.40 | 2.35 | 3.850 |
| Water . . . . . | | .50 | (not given) | 1.12 | 1.250 |

Valuable deposits of cannel coal occur in this region, the chief of which is in the neighborhood of the town of Cannelton. These deposits are, as usual, in the form of pockets of limited area, and generally referable to seam No. 4, or the supposed equivalent of the Upper Freeport seam of Pennsylvania. The cannel is found interstratified with splint or bituminous coal, and of varying thickness, though at Cannelton it gives 3½ feet. These cannels are of the usual dull gray slate color, and lie in the vein in layers, with a well-defined parting. Owing to their density and position, they are expensive to mine. They are extremely hard, and difficult to break in the vertical plane. Horizontally, they break with greater readiness, showing conchoidal fracture. Originally, this coal was mined for distillation for oil; but about 1873 was brought into the market as a gas enricher, where it has since held a position as one of the standards. There are in this region, no doubt, many valuable deposits of cannel as yet undiscovered, which further development of the coal-field will bring, literally and liberally speaking, "to light." At present, the extensive use of oil as an enricher of gas, curtailing as it does the use of cannel, does not stimulate investigation of the available area and supply of this grade of coal.

In an analysis, this cannel yields:

| | | |
|---|---|---|
| Volatile matter . . . . . | 43.10 | and 58 |
| Carbon . . . . . | 56.90 | 23.50 |
| Ash . . . . . | 7.40 | 18.50 |
| Sulphur . . . . . | 1.162 | (not given) |

Mr. E. V. D'Invilliers, in his early and extensive investigations in the great Flat Top region about Pocahontas, suggested the likelihood of the same conditions prevailing in that region, in regard to the relative qualities of the coals in the wide area extending thence westward through Virginia and northwestward through West Virginia and Kentucky along their mutual boundary line, as we find in the Pennsylvania and also in the Kanawha fields. That is to say, a gradual increase in volatile matter as we pass to the west and northwest. Hence we would expect to find gas-coals or coals of approximate character as we pass to the west and northwest along the line indicated through the Quinnimont (the Conglomerates of Pennsylvania) series of coal measures, as they are termed in this region. Very recent re-

search on an extended scale along the proposed Ohio extension of the Norfolk & Western Railroad, northwest from Pocahontas, Va., to the Ohio River, through Martin county, Ky., and Wayne and Logan counties in West Virginia, has justified that inference. Coals have been disclosed, high in volatile matter, and, so far as analyses and physical characteristics go, suggestive of valuable gas coal. They have not yet, however, been subjected to test in gasification, so that all that can be said is, that it is likely that that district contains a large area of good gas coal. As we found the West Virginia field lying southwest of the Pennsylvania coals, and the Kanawha southwest of the West Virginia, so we find the district in question lying in a continuation of that southwest line through the Kanawha field.

Investigations pursued in the southeastern end of the field in the valleys of Coal Creek in Tazewell county, Va., and in adjacent districts along the Clinch Valley Division of the Norfolk & Western, show that of the three seams generally exposed, one shows indications of a good gas coal, in a seam likely to average three feet clean. The analyses of samples indicate a good coal, and, so far, tests on a small scale have borne out the prophecies of the analyses. The working has not, however, as yet been of sufficiently extended character to warrant a positive statement as to the qualities for gasification. The most important question yet to be determined is whether the seam will run, on the average, sufficiently thick and clean to enable it to be mined readily and profitably. That, only further development can decide. I understand that active operations towards that end are to be undertaken at once.

Turning aside for a moment from our southwesterly course, we find in the vicinity of Richmond, Va., a small but interesting deposit of coal, running from a high bituminous to a natural coke, *i. e.*, where the igneous action has been more rapid than in the case of anthracite, and a less perfect result attained in carbonization. These deposits were of a much later period of continental life than the coal-fields of the western part of the State, and are believed to have been formed in what is known as the Triassic Age. The deposits of the bituminous coals are in places extremely thick, running as high as 40 feet. The best presents the following analyses:

| | Clover Hill. | Midlothian. |
|---|---|---|
| Ash | 10.132 | 14.73 |
| Water | 1.339 | 2.55 |
| Volatile matter | 30.984 | 29.73 |
| Carbon | 56.831 | 53.01 |
| Sulphur | .514 | .580 |

While these analyses make a good showing, yet in actual practice the coal as shipped to market is so highly charged with sulphur, and carries with it so large a percentage of ash, as to make it practically of small value in gasification in the presence of the superior grades of gas coal found in the markets to which it could be shipped. These Triassic coals have been used on a small scale in gasmaking, but in the short time at our command no recent record of its working could be obtained. Little work has been done in this field for many years.

There are also in North Carolina two small areas of Triassic coal. Little work has been done in these fields, likewise, of late years; but some of the coal, from what is known as the Deep River field, has been used in gasification, with results said to be satisfactory. But of this no record could be had.

The coal-fields of Kentucky are of two principal divisions, the eastern and the western. The eastern is of the Appalachian system of coals, and is an extension of the Kanawha and West Virginia and Southwest Virginia deposits, and covers the eastern half of the State. The western division is an extension of the great middle or Illinois coal-fields. Kentucky, in her eastern counties, is rich in coal-veins. Her coal-measures are tilted over at an inclination that exposes successfully their whole section. A dozen or more seams are found, all persistent and recognizable, in different and distant localities. She has been blessed, however, rather with number than excellence. Of the whole ten principal veins of coal none is of such uniform thickness as to make it of great commercial value. At times they show workable thickness of excellent coals, but the seams vary so, both in sections and in physical quality, that little dependence can be placed upon them. It is unlikely that they will be extensively developed while in the adjacent States thick veins are accessible. As in number of seams, so in variety of coal. We find nearly everything but anthracite here. The principal formations, however, are splint or block coal and free-burning, non-coking bituminous. Good coking coals are found, but gas coals are a rarity; and where they are discovered, none are of such generous formation as to make it likely they will ever be a considerable factor in the market, though analyses of local coals show excellent chemical compositions. The comments made upon the eastern coal-fields will serve as well for the western field, so far as general characteristics and its status as a producer of gas coal are concerned. The various seams, running from shale or bituminous coals to cannel, have made numerous and underspread deposits of the latter. It can be found in one or the other of the several seams, in varying quantities and of varying quality, nearly everywhere in the area underlaid by these coals. At times and in certain localities it attains an excellence of quality and magnitude of area that have made it a commercial possibility, and it is from this State that the majority of our best known and most desirable cannels come. To these we will now turn our attention. Of Kentucky it may be said that no other State has such a large area of rich and thick cannels. They are found in both the eastern and western fields and of good quality in nearly every county in the State underlaid by coal. The best cannels of the eastern field are generally found on what is known as seam No. 4 of the upper coals; but it is impracticable to relegate the best cannels in either field to a particular seam, so difficult is the determination of their equivalency. The cannels are found here, as elsewhere, in detached basins, in pockets of variable extent in area, and of no uniformity of thickness; hence, any estimate of their area in any locality is largely conjectural. The vein is generally very thin, running from eighteen inches to three feet, and composed of superimposed thick lamina, like slabs of slate placed one upon the other, underlaid by inferior shale or bituminous coal or clays.

Through these underlying strata the "bearing in," or undercutting, is done. The mining is generally very difficult and expensive. The color is the familiar dull, slaty gray, with, at times, highly polished fracture, which is always conchoidal. The coal is remarkably dense and tough, and strongly resists cross fracture, while it parts with comparative ease horizontally in the line of the lamina. These physical characteristics give it, of course, a structure that resists the rough handling of transportation, and admits of its being carried the longest distance in good condition. The chief carrier through the State is the Chesapeake & Ohio Railroad, though those coals along the Ohio River are loaded on barges and shipped along that great waterway to the Southern and Western markets. In some instances these cannels were first developed for the distillation of oil prior to the discovery of the large fields of free natural oil; as many as 120 gallons of oil being distilled, it is said, from 1 ton of the best of these coals. In the eastern field, Greenup, Carter, Boyd and Johnson counties are the principal producers of cannels; though in the centre of the field, about the head waters of the Kentucky River, in Breathitt and adjacent counties, excellent deposits are discovered, In the western field, Hancock and Breckinridge counties are the chief producers, and are famous the world over for the excellence of their coal.

The analyses submitted below will show the comparative composition of these coals in the various localities:—

| | Pike County. | Perry County. | Breathitt. | Breathitt. |
|---|---|---|---|---|
| Volatile matter | 43.4 | 44.16 | 68.28 | 53.8 |
| Carbon | 46.3 | 49.4 | 29.73 | 45 |
| Sulphur | .689 | .766 | .83 | .722 |
| Ash | 8.3 | 6 | 3.64 | 5.54 |

| | Hancock and Breckinridge. | Breathitt. | Greenup. |
|---|---|---|---|
| Volatile matter | 60.90—77.5 | 58.80 | 47.46 |
| Carbon | 27 —21.05 | 35.30 | 38.84 |
| Sulphur | 1.89 | 4.07 | 1.55 |
| Ash | 12.10 | | 12.10 |

These analyses will serve, in a very general way, to show the range of quality and the general characteristics of the coals. In coking they vary greatly, some producing a good merchantable quality, that may be readily mixed and sold with that of coking coals; while others, and the majority, make a small, soft, friable, and nearly worthless coke. The best of these coals compare favorably with the best English cannels and approach the celebrated Australian shale, and are already shipped to foreign countries in competition with them. So favorable have been the results of comparative tests that a large export trade in the future is confi-

dently looked for. It is a matter for congratulation that the determined area of some of the most valuable deposits reaches over a wide extent of country, running into the thousands of acres in some instances, thus insuring a practically limitless supply. Inadequate railroad facilities have been the chief obstacle in the way of the more rapid development of Kentucky cannels.

It is likely that the activity in railroad extension and industrial development through the South will render the markets of this country and of the world more readily accessible to the already developed coals, and lead to the discovery of many valuable, but as yet unknown, deposits.

The coal-measures of Tennessee are an extension of those of Kentucky, and, entering from that State in a belt some seventy miles wide, continue the general southwest trend through the State, generally narrowing as they pass southward until they enter Alabama, cutting across the extreme northwestern corner of Georgia. They occupy and are entirely confined to the Great Plateau of the Cumberland Mountains, a vast, narrow table-land running entirely across the State, north and south. There is no systematic geology of the State of recent determination, and as the Government make little or no provision for the compilation of statistics, or the filing of general information as to the progress of development of her coal-fields, individual reports must be relied upon entirely. Therefore, it is difficult to make a complete or exact statement covering the whole area of her coal field.

We may divide the field into northern and southern divisions. In the southern the coals are of a semi-bituminous character, and generally quite soft and friable, and extensively mined for manufacture of coke; but towards the northern border of the State, in Scott, Campbell and Anderson counties, some very good gas coals and some excellent cannels are found.

These coals lie in the upper coal-measures, in which are found in this district eighteen or more different seams of coal, all varying in thickness and in quality, and changing at times from bituminous coals to cannels or shales, as we found to be the case in the Kentucky fields. Most of the seams are thin and irregular and worthless, but there is one seam, to which each successive explorer has given a different name, that is of comparatively uniform and persistent thickness, and which furnishes the best coal, and the gas coal and cannel, in the northern field. In the vicinity of Jellico Mountain, in Campbell county, is found an excellent grade of cannel, which has been extensively shipped through the county for the purpose of gas enriching. The deposit is estimated to cover some twelve hundred acres, which insures its permanency in the markets. The coal analyzes as follows:—

| | |
|---|---|
| Volatile matter | 49.85 |
| Carbon | 35.03 |
| Ash | 15.12 |
| Sulphur | .74 |

The bituminous coal from the same district is a clean, hard coal, with cubical cleavage, and bears transportation well. That it will serve well as a gas coal, the following analysis will demonstrate:—

| | |
|---|---|
| Ash | 1.60 |
| Carbon | 60.60 |
| Sulphur | 1.16 |
| Volatile matter | 35.44 |

A very good gas coal, perhaps the best in this district, is mined in the southern part of Scott county. It is said to be similar to the best Pennsylvania coals in general physical characteristics, and to approach them in value in gasification. The coals found in the adjacent county, Anderson, are likewise of excellent quality. Some analyses are submitted to show their general character:—

ANDERSON COUNTY COALS.

| | Coal Creek District. | Poplar Creek District. | |
|---|---|---|---|
| Carbon | 57.52 | 60.67 | 56.120 |
| Volatile matter | 38.82 | 36.53 | 39.33 |
| Ash | 3.09 | 1.75 | 2.81 |
| Sulphur | .2 | .78 | |

All of which indicate a first-class gas coal. These coals are supplied principally to the local Southern markets, and are not extensively shipped as gas coals beyond the limits of the State. The greater part of the production of these mines is sold for domestic or steam-raising purposes.

ALABAMA.

Of the Alabama coal we may say, as Cæsar said of all Gaul, that it is divided into three parts. Those three parts were originally one whole field, lying in the northern half of the State; but subsequent geological disturbances threw up dividing anticlinal ridges that cut it into three pieces along its southeastern border. These three divisions have been named after the rivers that flow through and drain them, the Warrior, the Cahaba, and the Coosa fields, respectively. The coals contained within them cover an estimated area of 8,660 square miles, and are in numerous seams, of varying thickness. Geologically, the upper coals are of the inter-conglomerate series, and the lower coals of the sub-conglomerate measures. These coal-measures are of astounding thickness, in some places 3,000 feet, and containing 30 or 40 seams, aggregating nearly 50 feet of coal. They are the most southern coals in the United States, and are the terminus of the great Appalachian field, with which we started our inquiries in Pennsylvania, and whose southwestern course we have thus far followed steadily.

Mining was first begun in this State in the Cahaba field in 1853, and the growth of the development is well-nigh incredible. In 1860, only 11,000 tons were mined. In 1870, 30,000; in 1880, 300,000; while 1890 will produce close to the enormous quantity of 4,000,000 tons, placing it fifth in the rank of coal-producing States.

Taking up the various fields, we find the Cahaba lying along the river of that name, in Bibb, Shelby, and partly in Jefferson and St. Clair counties. The area is 400 miles. The coals are generally semi bituminous coking coals, running 25 to 30 per cent. in volatile matter, though in some districts the volatile matter rises to 35 per cent. and the coal is reputed to serve as a gas coal. Although it has as many as twelve seams of coal, some two feet six inches thick, the mining is expensive and difficult, on account of the steep dips of the seams, due to the disturbances of the containing measures.

We may say much the same of the Coosa field, lying to the east and northeast of the Cahaba, and having a like area of 400 square miles. Its coals are semi-bituminous, friable, and best suited for coking. The mining of them is likewise difficult, on account of the disturbance of the strata and their irregularity and steep inclinations.

In the great Warrior field, whose area is ten times as large as that of the other two combined, we find the principal deposits of good coals of all bituminous varieties, coking, gas, block, and splint. This field lies principally in Jefferson, Walker, Fayette, Marion, Winston, Cullman, Blount, and Tuscaloosa counties. In Marion, Winston, Cullman, and Fayette counties the seams are generally thin or split up, and unworkable; the coal is of a semi-bituminous character, and is not extensively mined. In Jefferson county is the principal coking region, where the coal for that purpose is taken from the famous Pratt, Black Creek, and New Castle seams, ranging from two feet six inches to four feet six inches in thickness, and furnishing an excellent coke. The coals are too low, however, in volatile matter, to rank as gas coals.

In Tuscaloosa county, while some of the coals, from their analyses, appear to be good gas coals, yet the seams containing them are either, on the one hand, too thin to be cheaply and easily worked, or, when thick, they have slates and clays so interstratified with them as to make it well-nigh impracticable to prepare them properly for the gas-coal markets; hence they do not, to any extent, appear there.

In Walker county, the coals are all highly bituminous, of the nature of gas, block or splint. The seams here are horizontal, easily accessible, thick and numerous. There are 35 over 18 inches, and 6 over 4 feet. The larger seams, and that furnishing the gas coal, have the familiar face and butt structure described in the Pennsylvania coals, rendering clean mining easy. We recognize here, though more highly bituminous, the great coking seams of Jefferson county.

The only commercial gas coal, properly speaking, is found in a deposit of area, of, say, 15,000 acres in the southwestern part of Walker county, in what is locally known as the Corona seam. It is mined in the Coal Valley, Cane Creek and Wolf Creek region. The seam runs 3 feet 6 inches to 3 feet 8 inches thick, with one slate parting. The coal is clean, bright, hard, with bright resinous lustre, and of sufficient density to bear handling well. It has rectangular cleavage, comes out in cubical blocks, with conchoidal fracture, and resembles very much the Pennsylvania gas coals. In preparation for market, the coal is first "forked" in the mine—

*i. e.*, loaded into the mine wagons by forks, with tines three-fourths inch apart, and then outside the mine is dumped over one-fourth inch screen. It is supplied to the local gas companies through the State, and in the adjacent States along the Gulf. The Georgia Pacific and Kansas, Memphis & Birmingham Railroads traverse this region, and are the principal carriers of the coals.

The analyses of the Walker county coals are:

| | Corona District. | Coal Valley District. |
|---|---|---|
| Carbon | 58.81 | 50.67 | 56.60 |
| Volatile matter | 37.74 | 41.12 | 32.67 |
| Ash | 1.90 | 7.36 | 9.41 |
| Sulphur | 1.95 | .42 | |

| | Cane Creek District. | Wolf Creek. |
|---|---|---|
| Carbon | 57 | 58.811 |
| Volatile matter | 33.78 | 37.735 |
| Ash | 6.96 | 1.953 |
| Sulphur | .73 | |

Small streaks of cannel are from time to time found running through these seams of coal, but none of commercial value or importance. The thickest seam is one found in Fayette county, running from 4 inches to 10 inches thick, which, while it is apparently of excellent quality, is, of course, not of a workable thickness.

OHIO.

The coal deposits in Ohio cover an area estimated at some 10,000 square miles. They are in the northwestern portion, and the limit in that direction of the great Appalachian field. They cover the eastern part of the State, running—roughly speaking—from Trumbull county on the north to Scioto county on the south, in a northeast and southwest trend. The measures here correspond directly to those of Pennsylvania, of which they are indeed a direct extension. They are, geologically, divided into two parts, the upper and the lower measures. In the upper, we find the familiar Pittsburgh seam; and in the lower, the equivalents of the Freeport and Kittaning veins of Pennsylvania. The principal seams are numbered from No. 1 to No. 8, beginning at the lowest or Sharon coal, and passing upward to the Pittsburgh. From the westernmost crop, where we find the lowest coal, No. 1, the measures sink towards the east, and expose the successive higher seams as we pass along in that direction, until, in the eastern part of the field, along the West Virginia and Pennsylvania State lines, we find the Pittsburgh seam.

The seams are characterized by regular dip and moderate inclination, permitting of easy and cheap mining. The general dip of the measures is towards the south and southwest, and here, as in Pennsylvania, we find along the general dip gentle folds or undulations, having the same northeast and southwest trend. The bulk of the coal mined in Ohio comes from the lower measures, the Freeport and Kittaning seams, the most important of which is the great No. 6 vein, of the Hocking Valley, the equivalent of the Middle Kittaning.

Ohio's coals are all bituminous, and may be divided into three classes: (1) The dry, open-burning block or furnace coal; (2) the caking or coking coals, which are by far the larger part; and (3) the cannels.

The Ohio Geological Survey, in speaking of the classification of these coals, says: "The division between coking and free-burning coals may be geographically made; generally speaking, from Perry county, southward, the coal is open-burning; to the northward and eastward it is of the cementing or coking type." This, of course, is a very general statement, as the most famous block coal of Ohio is the Brier Hill, of the Mahoning Valley, in the northeastern part of the State.

The principal use of Ohio coals is for steam. The block coals of the northeastern counties and of the Hocking Valley were largely used in blast furnaces; but the advent of furnace coke from Pennsylvania has nearly, if not quite, driven them out of use. So with the use of her coals for gas manufacture. The coals of Columbiana, Jefferson, Hocking, Meigs, and other counties were originally largely used for gas-making in the numerous gas-works that dot the State. But the incursion of the better coals from the adjacent Pennsylvania field, at low rates, has quite driven the Ohio coals into the background. It is doubtful if to-day half a dozen gas works in the State use the native gas coals; and then it will be found to be only where, so to speak, the coal is mined next door to the retort house, and almost shoveled from the mines into the retorts.

The Pittsburgh seam, the principal development of which is along the Ohio River and in Meigs county, depreciates in character and quality as it passes from Pennsylvania into Ohio. The vein thins out, and becomes less clean and pure. The ash and sulphur rise rapidly, and while the volatile matter remains as high as in the best gas coals found in this seam in Pennsylvania, yet neither is the volume of gas distilled found to be as great, nor the quality as good, by many degrees. A section of the coal in Meigs county, near Pomeroy, where perhaps the best gas coal in the State is found, shows a decided inferiority over the same bed as shown in section in Pennsylvania.

An average of analyses of ten coals from ten different mines in this region gives:

| | |
|---|---|
| Moisture | 4.81 |
| Volatile matter | 38.60 |
| Carbon | 50.05 |
| Ash | 6.51 |
| Sulphur | 1.42 |

The next field in importance, as a producer of gas coals, is the Hocking Valley, which at one time furnished a large quantity for gas-making, coming from the great No. 6 seam, or Middle Kittaning. The seam runs from 5 to 12 feet in thickness, but is interstratified with clays and bone coals, necessitating separation in mining, so that the whole depth of the seam cannot be mined out clean. The coal is hard, with bright, resinous lustre, holds a moderate amount of mineral charcoal, comes out in cubical blocks, and stands rehandling and transportation exceedingly well. Streaks of cannel are occasionally found running through the upper bench of this seam, which, of course, there greatly enhances the value of the coal in gas-making, but this cannot be relied upon, as the deposit is irregular, changing indefinitely into a shale or horn coal.

Here we find a good lesson as to the value of analyses in the determination of the exact value of gas coals, and, in fact, of any coals. The average analysis of ten of the best Hocking coals gives:

| | |
|---|---|
| Moisture | 5.93 |
| Volatile matter | 36.48 to 37.58 |
| Carbon | 52.41 |
| Ash | 5.13 |
| Sulphur | 1.09 to .516 |

which would, judging from the analysis alone, give a coal that might compete on their own ground with Pennsylvania gas coals; yet the volatile matter, when distilled, gives a yield decidedly inferior in quantity and in quality to that which a Pennsylvania gas coal of same analysis would have produced,

This variation and the reasons for it will, however, be a matter of future consideration, as space for it is not afforded here.

The same considerations apply to the other coals mined in different parts of the State, when used in gas-making. While making a good showing by analysis, they give decidedly poor results in the retorts. Their general characteristics are an unduly high percentage of sulphur and ash, which, of course, affords a very inferior grade of coke. As it is, owing to the proximity of the high grade Pennsylvania gas coals, Ohio may scarcely be said to possess any within her borders. Were her fields, however, more remote from or more inaccessible to the Pennsylvania deposits, they would be largely drawn upon by her gas companies; for by enriching the native gas coals with the native cannels, which we shall now consider, a good and cheap gas could readily be made.

The Ohio cannels are widely distributed through the State. They appear in the usual pocket deposits. They suddenly replace the bituminous coals in one of the regular seams, and then as suddenly disappear. Their area runs from a few acres in some deposits to 10,000 or 12,000 acres in others. They are principally referable to the lower coals, the Mercer (No. 3) and the Brookville (No. 4).

There is a large deposit in Muskingum county, in the Brush Creek basin, said to be 10 feet thick and to cover a wide area. In Coshocton county, Bedford and Jefferson townships, lies perhaps the largest deposit in the State, from 1 to 6 feet in thickness, and covering an area 12,000 to 13,000 acres. Considerable areas of it are found also in Holmes, Licking, Jackson, Scioto and Mahoning counties.

In the last-named county it is known as the Canfield cannel, and is considered the equivalent of the Darlington deposit of Pennsylvania.

The Ohio cannels are of small economic value. They are rarely or never developed on their own account, but generally in connection with the mining of some adjacent bituminous coals. They are not high in volatile matter, do not yield a rich gas, and have an excessive quantity of sulphur and ash, which latter averages 12 per cent. They are used locally within the State in gas enriching, and in adjacent States, at points near by. Wherever they meet the Southern cannels of higher grade on competitive grounds, they are generally soon driven from the field. To give a general idea of the composition of these coals a few analyses show the following determinations:

| | Coshocton Co. Bedford Cannel. | Jackson Co. Flint Ridge. Cannel, *Selected.* | Licking Co. | |
|---|---|---|---|---|
| Water | 2.35 | 2.32 | 3.47 | About |
| Volatile matter | 47.05 | 44.52 | 43.85 | the |
| Carbon | 37 | 41.13 | 43.72 | same. |
| Ash | 13.60 | 12.03 | 8.96 | |
| Sulphur | 2.33 | .84 | .76 | |

As we turn westward from the Appalachian system we shall find little gas coal, properly so-called, and few deposits that are drawn upon more than locally for that purpose. The Pittsburgh coals are carried out into the far West, and their use at as far distant points as the towns of Iowa, Missouri, and Nebraska is conclusive proof of the non-existence in those neighborhoods of native gas coals of much worth. Following the course of Empire, we find next after the Appalachian, the great middle or Illinois coal-field, extending over the State of Illinois, and over the western part of the State of Indiana, and the northwestern part of Kentucky. Then next adjacent we find the western coal-field of Iowa and Missouri, extending southward into Kansas, Arkansas, Texas, and Indian Territory. In this field lie the westernmost deposit of the Carboniferous period. Towards the Pacific coast the coals in the fields of Colorado, Washington, Wyoming Territory, Dakota, Utah and Oregon are of much later formation, known as the Cretaceous age, and of much higher geological order. They are lignites, or bituminous coals of the lignitic order.

Turning first to the great middle or Illinois coal-field, we find we have already considered that portion of it that lies in the northwestern part of Kentucky, so that there remains for our inquiries only those portions lying within the States of Indiana and Illinois. Since there is in those States no gas coal, properly speaking, or any deposits of great importance as a producer of gas coals, it will not be profitable for us to take up the systematic geology of the coal-measures; we shall confine ourselves, therefore, to a few cursory comments upon the general character of the coals.

In Indiana, as in Ohio, we find that the carboniferous measures in the southwestern part of the State contain a great variety of coals, running from a splint or cannel up to a high-grade bituminous. With the exception of the cannel, we find no coals of much economic value as gas coals. Although in analysis many of the coals show excellent composition, their behavior in the retorts disqualifies them from use in gas-making, except to a limited extent. Generally the coke is poor, and the gas yield small in volume and poor in quality. The native coals of Indiana are now little, if at all, used by the gas companies within her borders. The superior Pittsburgh gas coals, brought at low prices from the adjacent field, have supplanted those native coals that formerly were so used, and it is not likely that a return to them will ever be made. In Daviess county, the coal from the seam known as "K" was once quite extensively carbonized by adjacent gas companies. It is a clean, bright coal, analyzing as follows:

| | |
|---|---|
| Carbon | 60 |
| Ash | 4.50 |
| Volatile matter | 35.50 |

which will give a general idea of the character of this coal, which, with other like ones, the advent of the Pittsburgh coal shut out of the gas-coal market.

Also in Daviess county is an extensive deposit of cannel, mined from a vein 3 feet 8 inches to 5 feet thick, and of very fair quality. It comes from one of the upper beds of the coal-measures, known as "I," and an analysis determines as follows:

| | |
|---|---|
| Ash | 6 to 20 per cent. |
| Carbon | 40 to 27.473 per cent. |
| Volatile matter | 51 to 50.80 per cent. |
| Water | 3 to 1.29 per cent. |

There is also a large deposit of cannel of fair grade in Perry county and local pockets are found at many points throughout the coal regions; none of these, however, have more than local reputation or use.

Almost the whole State of Illinois is underlaid by her coal-measures, which cover an area of some 36,000 square miles, and contain some 15 distinct beds. The available veins are generally of good working thickness, and readily accessible, though for the most part through shafts, owing to the depths at which the best veins lie. The principal centres of operation lie as yet upon the margin of the field, but are being rapidly developed and extended. The annual output is enormous. In 1889, it rose to nearly 12,000,000 tons, placing this State second in the rank of coal producers in the United States. A territory of such great productiveness would seem to merit lengthy consideration at our hands; but it does not. While there is more native coal used in gasification in Illinois than in Indiana, it is not because the coals are better, but because of their greater remoteness from the Pittsburgh field. The Illinois coals are all of a bituminous nature, and of excellent quality for steam production; but of small value as gas coals. They are for the most part highly charged with moisture, running from 6 to 8 per cent., and also high in sulphur. They are very friable, and liable to disintegrate on long exposure, or in the handling incident to transportation. Those faults alone preclude their use as gas coals to any great extent. The yield of gas is low in quantity and quality, and the coke generally poor, light, and soft. In fact, the use of the native coals is generally confined to those points where they, so to speak, underlie the gas-works, as is true in many cases, and the cost of transportation is reduced to almost nothing. The constantly declining price at which Pittsburgh coal is being offered, is gradually ousting the Illinois coals, and with the further lowering of freight rates from Pennsylvania, we may look for their total exclusion from the gas-coal arena. So far as can be ascertained, no coal is carried from Illinois to any adjacent State for the purpose of gasification.

A few analyses are submitted to show the general character of the coals:—

| | Big Muddy District. Jackson County. | Duquoin District. Perry County. | Belleville District. St. Clair County. |
|---|---|---|---|
| Water | 6.5 | 8.5 | 6.8 |
| Volatile matter | 31.2 | 40.4 | 33.35 |
| Carbon | 60.8 | 59.6 | 54.55 |
| Ash | 1.5 | 3 | 5.9 |

| | Danville, Vermillion County. | La Salle County. | Bloomington. |
|---|---|---|---|
| Water | 4 | 10 | 7.90 |
| Volatile matter | 40.58 | 27.40 | 34.02 |
| Carbon | 46.78 | 55 | 53.12 |
| Ash | 8.64 | 7.60 | 4.96 |
| | | | Sulphur 1.97 |

Leaving out of consideration what is known as the third, or "Michigan" coal-field, which is of small economic value, and not within the scope of our inquiries, we turn with interest to the fourth, or Western field, representing the western boundaries of the carboniferous measures. Here we find 2 gas coal-fields of no inconsiderable consequence, each supplying a large adjacent area, and each of wide and well-defined reputation. Kansas and Indian Territory are the two possessors of this distinction, and will command our attention for the most part in considering this field. Iowa, representing the northern portion of the Western field, has within her boundaries no gas coals, and draws, curiously enough, her entire supply from Pennsylvania. Her own coals are high in moisture, sulphur and ash, and of the same general physical character as the Illinois coals. The explanation of the general use of Pittsburgh coals in this State is likely to be that the low through rates bring the Pennsylvania product to her gas-works as cheap as it is laid down at points much farther east. Of Nebraska, it may be said that she has no gas coals, and not much of any other.

Missouri demands more extensive notice. While Kansas and Pennsylvania coals dispute for the gas-coal supply, still some native coals are used, where the deposits are of fair quality, and so near by as to make the cost of transportation low. The coals are all of

bituminous character, and the operations are principally found in the western and southwestern counties, adjoining the Kansas field. The most important coal centre is in Bates County, where a vein of good workable thickness is found. The seams run from 3½ to five feet thick. There is no extended and systematic recent survey of the fields, and little information in regard to them. The coals are, however, not of high grade, being soft, friable, sulphurous, and high in sulphur and ash.

A characteristic analysis is submitted :—

| Lexington Coal, from Fayette County. | |
|---|---|
| Ash | 7.71 |
| Carbon | 45.32 |
| Volatile matter | 36.34 |
| Water | 10.63 |
| Sulphur | 2.93 |

There are large deposits of cannel coal in Missouri, lying in large pockets in the Osage River field and along the Missouri River. The principal developments are in Moniteau and Cooper counties. The cannel pockets, which are simply local, irregular, and varying enlargements of the regular bituminous veins of coal, are of great thickness at times, running as high as 72 feet. No record of the use or value of this cannel in gasification (or of its physical characteristics or its analysis) has been obtainable.

The coal-fields of Kansas lie in the eastern part of the State, in the counties along the Missouri State lines and extend from Missouri through Kansas into Indian Territory. The thickest and most valuable deposits are found in the Cherokee vein, as it is called, in Crawford and Cherokee counties, in the extreme southeastern part of the State. Here only is the gas coal found. The other coal-fields of the State, in Osage and other counties, are characterized by very thin veins, seventeen to twenty inches, of lean, poor coals; and in the centre of the State, beyond the boundaries of the coal-field proper, some inferior lignites are developed, but nothing approaching a gas coal has been discovered.

The Cherokee vein crops through the eastern part of Crawford and Cherokee counties, and is in an accessible bed some twenty miles long, in a northeast and southwest line, and of one to two and a-half miles wide. The vein dips slightly towards the northwest, while the general containing measures sink rapidly towards the west and southwest, disappearing in the western part of Cherokee county, to rise again in Indian Territory. The workable coal runs from three to three and a-half feet thick, though in some places it rises as high as four feet, and is badly cut up by disturbances known as horse backs and clay veins, rendering mining at once expensive and uncertain.

The mines in this district are very large, and well equipped and developed, and the output is quite large. The coal is black and lustrous, with a cubical cleavage, and fairly firm and dense, though it disintegrates rapidly, like most of its western neighbors, upon exposure to the atmosphere.

It is high in sulphur and in ash, but not in water. It may fairly be said to be a good gas coal, though the high percentage of sulphur and ash are great drawbacks. It yields a fair quantity of gas, of good illuminating power, and the coke is strong and plentiful, say sixty per cent. but, of course, highly sulphurous. The average analyses of nine samples of this coal determined as follows :—

| | |
|---|---|
| Water | 1.94 |
| Volatile matter | 36.77 |
| Carbon | 52.45 |
| Ash | 8.84 |

The sulphur runs from two and one-half to five per cent. and as high as eight per cent. in some of the coals.

The Cherokee supplies nearly all the Kansas gas companies, and the majority of those of Missouri, but it has a formidable competitor in the Indian Territory coals.

In considering Indian Territory as a gas-coal producer, we shall find that the only field lies in what is known as the Choctaw country, which is that portion set apart for the use of the Choctaw Nation of Indians, lying in the southern part of the Territory, From that nation the operators in this district are obliged to secure leases, subject to governmental ratification, before developments may be proceeded with ; and from the royalties thus secured a handsome income is had.

The coal-measures are a part and continuation of the great Fourth Field, and an extension westward and southward of the Arkansas Missouri and Kansas deposits, though they are here found of far greater thickness than in any other part of the field so far as now explored, and show a total depth of some 8,500 feet. Although this region has long been known as a producer of excellent coal yet particular attention has been recently attracted to it through new and extensive developments that are being made within it. To Mr. H. M. Chance, of Philadelphia, who has conducted the careful and widespread researches into the resources of coal deposits that have led to these new operations, we are indebted for the information in regard to them.

The coal developments are embraced in the region lying between the Missouri, Kansas & Texas Railway and the Arkansas State line, and we have now to note again, as characteristic of this region, also that the coals toward the east are low in volatile matter, semi-bituminous in character ; while as we pass westward, over what are known as the Mitchell and Mayberry basins, we find a gradual increase in volatile matter until we reach the high percentage found in the gas coal of the Grady or McAlester beds. The original operations in this district were at the town of McAlester, on the Missouri, Kansas & Texas Railway, and that town is given its name to the bed principally worked, and in fact to the whole region.

The developments of the best coals are all from veins lying in the lower part of the coal-measures, and are principally confined to two, the McAlester, which is next to the lowest bed in measures ; and the "Grady," which is the lowest deposit. The McAlester, the most largely worked bed up to the present time and also the most extensive in area, long ago demonstrated the superiority of its coal over that of adjacent States ; but the recent development of the Grady basin has brought to light a coal which, while of the same general character as the McAlester, is of greater and surprising excellence.

These veins run from three and one-half to five feet in thickness, and are generally entirely clean, *i.e.*, free from bone or slate binders. They are mined by drifts near the outcrop, and by slopes or shafts at points further in the basin, where the coal sinks away from the crop line. The coal is bright, clean, and hard ; has the lustre and general appearance of the Pittsburgh coal. It stands transportation well, and does not disintegrate readily, as might be supposed, upon exposure to atmospheric influence. It possesses a well-defined cubical cleavage, and is interstratified with the mineral charcoal so abundant in the Eastern coals. It is mined in large, clean, cubical lumps, and to the eye of even an expert it might readily pass for the Pittsburgh seam. This is particularly true of coal from the Grady bed. It may, perhaps, be safely said, that here is to be found the best coal west of the Appalachian fields. In its freedom from sulphur, ash, and moisture, in its density, its superior coking qualities, and in its general physical characteristics, it may be said, considering the field from which it is drawn, to be truly a wonderful deposit.

The following analyses confirm the above statements :

| | Grady Basin. | Grady Basin. | McAlester Bed. | Grady Bed. |
|---|---|---|---|---|
| Water | 1.792 | 1.709 | 1.804 | 2.478 |
| Volatile matter | 40.207 | 38.668 | 37.171 | 37.797 |
| Carbon | 51.785 | 51.482 | 53.404 | 55.270 |
| Sulphur | 1.333 | 1.006 | .896 | .950 |
| Ash | 4.883 | 7.135 | 6.725 | 3.505 |

As we leave the district lying at and immediately east of McAlester, the coals deteriorate in quality and rise in impurities, particularly in sulphur and moisture. This McAlester region is now being very rapidly developed, and the badly needed facilities for transportation are being furnished with all possible haste. The coal has found its way to the gas companies of Texas, Arkansas, and Kansas, and no doubt it will rapidly extend its market as more distant ones become accessible.

In gasification, this coal gives a large yield of good gas and excellent coke. In fact, its results approach with surprising closeness those obtained from the standard gas coals of Pennsylvania.

Standing on the western edge of the fourth or Western coal-field, which we have just considered, and looking over the wide area of the western half of the United States, we find that all the coal deposits are of recent formation, comparatively speaking. With the Kansas and Indian Territory fields we have left the coals of the carboniferous measures behind us, for while rocks of the carboniferous era are found further out through the West, they do not contain coal. That which is found in the area under present

consideration belongs to the Cretaceous age, and is generally lignite, or coal of lignitic character, heavily charged with moisture and high in ash. To that rule there are some exceptions, notably in the Colorado fields.

What treasures in the shape of gas coal the vast unexplored Wild West may have hidden in the bowels of its hills and mountains, we cannot say. But we can, however, safely predict that it is not likely that any will be found equal to the best gas coals of the East, though some may be discovered that will approach them.

Owing to the lack of development and discovery of native resources, the Pacific Slope draws nearly its entire supply of gas coal from Australia. Recent increased facilities in transportation, however, have brought the native coals to the front, and no doubt their use will be largely increased in the near future. The principal native source of supply for the Pacific Slope is the State of Washington. The principal coals of this State used in gasification are the "South Prairie" coal, on the Northern Pacific Railway, just south of Tacoma, in King County, and the "Roslyn" coal, in Kittitas county.

The "South Prairie" coal is mined from a bed four feet thick. It is soft, rather dull in appearance, and gives seventy to eighty candle feet of gas to the pound carbonized. The coke, while of fair quantity, is poor in quality, soft, and light. No analysis of the coal could be had.

The "Roslyn" coal is mined from a vein some five feet thick, covering an area of some twelve thousand acres, and its principal use, so far, as is also the case with the South Prairie coal, has been for steam purposes on the Northern Pacific Railway. Its yield in gas-making and its general physical character are like the South Prairie coal. In analysis it determines:—

| | |
|---|---|
| Carbon | 60.61 |
| Volatile matter | 27.72 |
| Water | 2.77 |
| Ash | 8.80 |
| Sulphur | .10 |

It is stated, however, that, as the development of these Washington fields proceeds, a better quality of coal is being found, and one which gives more satisfactory comparative results in the retorts.

In Montana, the "Cinnibar" coal, mined in what is known as the Bozeman field, in Madison county, is used in gas-making by the adjacent gas-companies in Montana and Washington, with fairly good results. It is described as of medium density, with cubical cleavage, and of fairly clear and bright color. It yields sixty-eight to seventy-five candle feet of gas to the pound, and gives a good quantity of medium quality coke. Detailed information and analyses of the coal of this field could not be had.

Colorado affords a striking example of the fertility of a well-developed field, not long ago comparatively unknown. Within her borders we find nearly all grades of coal, from a high bituminous to anthracite, and thence even to graphite.

The State has suffered severe volcanic action, and thus the original bituminous deposits have been carbonized, as it were, into anthracites by the heat evolved by and consequent thereupon. The formations are all of the upper Cretaceous period, but the deposits are of remarkable excellence for that era. Little lignite, which comprises so large a portion of the general cretaceous formation, is found; while the coking and anthracite fields together cover an area of some 30,000 square miles. The coal taken from Colorado, and used for gas-making, is found in 2 fields, the Trinidad, near the Raton Mountains, in Las Animas county, on the southern border of the State; and in the Crested Butte field, in Gunnison county, near the centre of the State.

The Trinidad field covers an area of 750 square miles, and extends to the southward into New Mexico. The main seam worked, known as the Trinidad, is from 6 to 14 feet thick. It has the face and butt cleavage described in the Pittsburgh coals, has a bright bituminous lustre, and comes out in large, firm blocks, and does not slack rapidly on exposure. The coal cokes well, and gives in gasification a good yield of fair quality gas, reported as 81 candle feet.

A fair set of analyses gives:

| | | | |
|---|---|---|---|
| Water | .61 | 1.26 | 2.66 |
| Volatile matter | 33.18 | 36.40 | 36.71 |
| Carbon | 57.56 | 53.10 | 51.41 |
| Ash | 8.65 | 9.24 | 9.22 |
| Sulphur | .751 | 1.11 | 1.37 |

which certainly show remarkably low percentages of ash, moisture, and sulphur—always bearing in mind the age of formation of the coal, and the region in which it lies.

Turning to the Crested Butte region, we find ourselves at the famous anthracite formation, which, though a pure, bright, hard coal, is of so small area as to be of small importance commercially for the future. The adjacent deposits of bituminous coal are not quite equal in quality to those of the Trinidad bed, being softer and more friable. The seam that is worked runs about six feet thick, and is highly charged with fire-damp, making great care necessary in mining. It is a clean, bright coal, making a firm, compact coke, yielding 60 to 70 per cent. It is reported to give over 80 candle feet of gas to the pound carbonized.

In analyses it determines:

| | | |
|---|---|---|
| Water | 1.17 | 1.94 |
| Volatile matter | 36.80 | 38.18 |
| Carbon | 58.01 | 56.80 |
| Ash | 4.02 | 3.08 |
| Sulphur | .454 | |

These determinations disclose here also coals closely allied in their chemical composition and physical characteristics to the best Pennsylvania coals, and approaching them in economic values.

The Colorado fields supply the gas companies of that and adjacent States. So far as can be ascertained by necessarily hasty search, there is no other deposit of coal in the vast Western territory, lying beyond the fourth coal field, where coal is more than locally used in gasification. Here and there are gas companies drawing upon deposits lying, comparatively speaking, at their doors, but disclosing no field of large development or great promise.

It is, however, by no means hence to be argued that such fields do not exist. They may lie as yet undiscovered, awaiting the further growth and development of the country to disclose them. It is, in fact, fair inference to say that they do exist. The results of recent exploration in adjacent regions justify that assertion. And, furthermore, as to whatsoever the Great West may lay claim, who can say it nay?

What thought is uppermost in our minds, after having made this long journey through the coal-fields of our country? What fact remains most persistently before us? What fruit has this search borne to us? This, I take it: that we have discovered a vast deposit of raw material, which merits more than passing consideration at our hands.

We have found in one State alone, a deposit, and that the best, sufficient, roughly speaking, for centuries to come. We have found other deposits of approximate excellence scattered through our broad land at convenient distances. The total area of these is almost incalculable; and yet we have looked at only the known and the developed resources. We believe there are as yet undeveloped and unknown resources equally great.

Here, then, is a constant factor in the problem of raw material. Here is a field which we may confidently till. Here is a rock upon which we may safely build the castle of our calculations. What other raw material for the manufacture of gas presents these same advantages? I think we may safely say, there is none.

Two problems present themselves in these considerations. The first is to the miner and vendor of these coals to reduce the cost of their extraction from the earth, and of their transportation to market. The second and greater one is to the gas engineers, to develop the resources and amplify the product of the coal.

In the first task, progress has been rapid of late years, and if not equal, yet continual progress may be looked for in the future.

The better methods and more scientific practice of mining tend to reduce the cost of the coal at the pit mouth. Yet that is in this land of magnificent distances a small factor in final cost. Cost of transportation is the chief element in its determination. And here we may look for the principal reductions. The improved road-beds, the more powerful machines, the more intelligent management of our railways, have already greatly reduced the cost of carrying raw material. And the extension and development of our already enormous railway systems will accomplish much more In hardly any other line of mechanical engineering is more promised and confidently looked for than in this question of cheap and rapid transportation. The advances of the last ten years speak for them-

selves; should they be more than duplicated in the next decade which we may confidently hope for, have we not much to expect?

So much for the delivery of the coal at the point of its manipulation. The task of resolving the secret resources, of developing and determining its possibilities, is a much higher and difficult one. And here we are led to ask whether this task has been wrought upon as it deserves? Has it not to some extent lain neglected? Is the apparatus of the manufacture and resolution of the coal of high mechanical order or great ingenuity of design? Have we not lingered here too long, perhaps, in the ways of our fathers? Have the same ability, energy, enterprise, money and time been devoted to the development of apparatus for the extraction of gas from coal as have characterized the researches and development of other processes of illumination?

Is this because the possibilities of gas coal as a source of production of illuminants have been exhausted? That can hardly be held to be so. Have we reached the Ultima Thule, in our search after the perfection of development? Certainly it does not seem that we have? Who can say that all the energy of the coal has been developed, or that its hidden treasures have been discovered? Is the process of retort distillation to be the last, as it was first, method of extraction of the gas? Is that practice which drags its slow length along, the measuresof our abilities and ingenuity? Is there no more rapid, effective, and economical method within reach of our inventive genius? Do we exhaust the coal of its illuminants in our carbonization as at present practiced, or do we pour out and practically throw away into our tar-wells more light-producing elements than we have carried into our holders?

These and a hundred other questions crowd upon us in looking over this field of work. And do they not merit serious consideration.

It is not within the scope of this paper to dwell upon these questions, or to answer them; but it is perhaps within its province to suggest them. The answers lie with the gas engineers; and they, that have committed to them this magnificent task of furnishing light to their fellow-men, must take some thought for the morrow. They must build upon lines of stability and permanence. How high and lasting a superstructure may be erected upon the broad and lasting foundation we have disclosed!*

*Discussion.*

The President—Mr. Adams and his paper are placed somewhat at a disadvantage here, it being impossible to treat a question of this kind in a paper as short as we ordinarily have presented to the Association. I think each and every one of you will find it advisable to retain a copy of this paper, and not only to read it but to study it. It is a paper that requires absolute study and quiet consideration. Mr. Adams will be glad to answer any questions that you may ask.

Mr. A. C. Humphreys—I would like to follow in the line that the president started in on, and to say that I think we ought to try to impress upon Mr. Adams that no discourtesy is intended to him by the absence of members, or by the necessity of skipping portions of the paper. It is of a class of papers that must be carefully read to be appreciated. I think that it would be to our interest in the near future, when the finances will permit, to have the papers printed in advance of each meeting, and distributed to the members, and then they need not be read before us in full, but read by title. We are now depriving ourselves of many valuable papers—or rather of the opportunity of discussing them—by lack of opportunity to study them beforehand. This is certainly a most valuable paper, and one that will be useful to us.

Mr. Adams—I thank you for your kind words, and I present this paper to the Association as a record of what I have done. I hardly think it is a paper that can be discussed in this short time.

Mr. A. E. Boardman—Mr. President, I agree with yourself and Mr. Humphreys in your estimates of the value of this paper. I would add that I think it is one of the most important papers that has been presented to us, and I believe it will remain as one of the standards for reference, not only by this Association, but by all who are interested in the production, distribution and sale of coal generally. It marks a new departure in the papers presented, read and discussed at these meetings. It is one of the few papers that we have had presented in years which is too great for our consideration at the meeting, but which will become a matter of reference for us in years to come, and will be copied not only in our own JOURNAL, but will have a life in the future beyond that. None of us would care to discuss the points made or the conclusions stated by an expert in this business. We will have to accept this paper, feeling sure that it has been compiled from reliable sources. I hope that it is the beginning of many more such papers that will take the time and study of members of this Association—papers that are ephemeral in their nature, to be disposed of at one meeting, and perhaps never again referred to, but such as will become a permanent record of a valuable literature which will spring up around our profession.

Mr. Littlehales—Can you give us an idea of what is the actual limit of sulphur that you have found in coal? I ask the question because I had a dispute with a member yesterday as to the amount of sulphur that could be found in gas coals.

Mr. Adams—I believe in some gas coals the sulphur runs as high as 5, 6 and 7 per cent. I think Mr. Chollar can bear me out in that assertion, as the Kansas coals probably contain more sulphur than is found in any other sorts.

Mr. Chollar—In reply to that question I cannot say positively what the percentage of sulphur is in some of our Western coals, but I think that the gentleman is about right in saying that it is as high as 6 per cent. It has been so bad that I have frequently appealed to our coal dealers to put a little more coal in with the sulphur.

On motion of Mr. Beal the thanks of the Association were voted to Mr. Adams.

### APPOINTING A COMMITTEE OF ARRANGEMENTS.

The President—The Council suggest the following names as the committee of arrangements for the New York meeting: Messrs. W. R. Beal, W. H. Bradley, Eugene Vanderpool, Oscar B. Weber, F. S. Benson and the Secretary. What will you do with that recommendation? (Adopted, on motionof Mr. Boardman.)

### SOME MATTERS OF DETAIL.

The President—The question was raised a while ago whether there would be a meeting of the Council to take into consideration the recommendation of the committee on the president's address with respect to amendments to the constitution. In looking over the constitution I find that such a meeting is not necessary. If the proposition is suggested at this meeting, the Council may at the next meeting offer it for adoption; and they must do so if requested by five members. It was requested by five members, and the request was ratified by the entire Association; so that they are pretty sure to bring it in at the next meeting. A suggestion was made that we have taken no action relative to the announcement of deceased members. At our Council meeting that question was taken up, and the suggestion was made that it had been customary heretofore to have the proper notices printed in our proceedings, but that there was no special action taken at the meeting. That is the reason that the chair has not suggested that there be a committee appointed. It is an unusual custom with this Association (although it is the custom in other associations), but the Chair is ready to hear any suggestion which may be made upon that point.

Mr. Humphreys—It might perhaps interest the members to hear read the letters of regret that have been sent in—some of them worded in such a way that the members would have liked to hear them read—but it seems impossible to read them all. Among them are letters from General Hickenlooper, Mr. C. H. Nettleton, Mr. Edward Lindsley and many others, all expressing special reasons for not being present.

The Association then ordered a recess until 2 P. M.

(To be Continued.)

*THE APPENDIX.—The author desires to acknowledge his indebtedness to the *Geological Survey of Pennsylvania*, with especial reference to the work of Mr. E. V. D'Invilliers; *Kentucky Geological Survey*; *Alabama Geological Survey*; *Ohio Geological Survey*; *Indiana Geological Survey*; *State University of Kansas*; *Colorado School of Mines*; *Officers of the Norfolk & Western Railway*; *Officers of the Choctaw Coal & Railway Company*; *Mining Statistics Division of the Census*; *State Mine Inspectors of West Virginia, of Illinois, and of Kansas*; *Franklin Institute*, of Philadelphia, Pa.; *A. N. Humphreys*, of Irwin, Pa.; *R. H. Sanders*, of Philadelphia, Pa. Also, to many others for their kind assistance; but finally, and most especially, to the officers of the gas companies of the country for prompt and full replies to the inquiries made of them.

## SPECIAL ENGLISH CORRESPONDENCE.

COMMUNICATED BY NORTON H. HUMPHRYS.

SALISBURY, Nov. 10, 1890.

*Competing with the Electric Light.—Use of Gas Stoves in London.—Registration of the Gas Institute and of the Institution of Gas Engineers.—Products of Combustion from Coal Gas.*

Mr. S. Bark, the manager of the gas works at Godalming, has introduced a scheme for competing with the electric light, so far as arc lights are concerned. And he has wisely brought it out without waiting for the actual advent of the new method of lighting. The town council at Godalming had been discussing for some time the question of introducing electric lighting in their streets—whether with any real intention of doing so, or merely with the idea of trotting out a bogey to frighten the gas company into lower terms for the street lighting, I cannot say. A report on the subject was prepared by the lighting committee, discussed at a meeting of the council, and adjourned for a fortnight. Immediately Mr. Bark set to work, and by the time that the date for the adjourned meeting came on, had several large gas burners in actual use in the public streets, thus affording practical illustration of the fact that if the public require brilliant lights the gas company can supply them. The arc lights are certainly rated very extravagantly as being equal to 1,200, 1,500, or 2,000 candles. But this game is now played out, and it is generally known that a so-called 2,000 candle arc light is equaled in practical lighting effect by a 150 candle gas lamp. Mr. Bark's scheme is to fit up large gas burners, free of first cost, for any customer desiring such, and to supply the same with gas at a cheap rate. A fixed charge, payable quarterly, covers the whole expense of gas, lighting, cleaning and repairing. An agreement with the customer is entered into, stipulating the hours of burning, etc., etc., and also containing a clause to the effect that in the event of the contract being terminated before the expiration of ten years, the consumer is to pay the cost of the lamps, brackets, less 5 per cent. per annum for depreciation. In fixing upon the charge for gas, a basis of one shilling per 1,000 cubic feet less than the usual selling price has been taken. So far the scheme appears to be attended with success, as a number of lamps have been fixed on above terms. And perhaps the sight of the capabilities of gas, thus afforded, had something to do with the decision of the council to postpone the question of electricity for a year, and to light the streets with gas, meanwhile. Leaving electricity out of the question, Mr. Bark is to be congratulated upon having struck out a new line of business that is likely to prove advantageous in more ways than one.

I have just seen an interesting return as to the number of gas stoves in use in London, which affords a useful indication of the extent to which gas is applied for purposes other than lighting in the country. It is the more striking when we remember that the largest company—the Gas Light and Coke—was decidedly behindhand in this matter, and has only taken it up within the last few years. Taking, first, the six months, ended June 30th, last, it is stated that during this period the Gas Light and Coke Company sold 1,514 stoves and let 6,369 on hire; the South Metropolitan sold and let on hire 2,664 stoves; and the Commercial 429, of which 263 were cooking, and 166 heating stoves. The Gas Light and Coke Company have about 220,000 consumers, and up to June 30th last they have sent out 29,703 stoves, of which 6,236 were sold and the remainder let on hire. The South Metropolitan Gas Company, with 72,650 consumers, have 13,654 stoves, out of which only 871 were sold. And the Commercial Gas Light Company have disposed of 1,467 cooking and 1,292 heating stoves, or a total of 2,759 amongst 20,960 consumers. The total number sent out is rather over 46,000 stoves, and it is remarkable that no less than 11,000 were issued during the period in question. This shows a rapid rate of progress in the adoption of these appliances. Out of about 314,000 consumers, 46,000 at present use stoves. But these figures require correction in two ways. Firstly, it is possible that, especially as regards heating stoves, one consumer may use several stoves. Secondly, there are several firms in London who make a specialty of gas stoves and continually have them on sale, so that the figures above given do not include large numbers of stoves supplied by shopkeepers. This especially applies as regards the smaller and cheaper kinds. It will be seen that the majority of those who patronize the gas companies wish to hire, which means that they require comparatively costly stoves. But large quantities of appliances, costing less than say 20 shillings in the first place, are on the market, and in most cases would be bought at a shop. Bearing these considerations in mind, we may safely add 50 per cent. or so to the figures above given, in order to arrive at something like the total number of stoves in use. This would give, at a rough guess, above 1 stove to 4 consumers, so there is yet plenty of room for further development.

One of the numerous peculiarities of our English law is the position of a subscriber to a society formed for any purpose—it may be a Gas Managers' Association, a benefit club, a charitable institution, or a trading company. Each of these widely differing associations is in the eye of the law one and the same thing. Unless properly registered as a joint-stock company it has no legal status whatever. There is no power to enforce rules or to recover debts. As a set-off against this each member enjoys the privilege of not only being collectively but individually liable, to the extent of the whole of his estate, for the debts and liabilities of the concern. So it is important that every Association of any importance should be registered. Bearing these points in view, the Council of the Gas Institute have applied for registration and been successful in obtaining it. The rules of the Gas Institute have thus acquired a legal status in any court of law. It will not be possible in the future for any one member who chooses to be obstreperous to defy the remainder to carry out their rules; whereas, before registration, if a member chose to refuse to abide by the rules there was no way of forcing him to do so. Each member will now be liable to the extent of the annual subscription prescribed in the rules, and no further. Which is a most important feature, for it is impossible to be too accurate on the subject of liability.

I have on previous occasions referred to the fact that a movement was on foot amongst those gentlemen who retired from the Gas Institute, for the promotion of another Gas Managers Association. Evidence that such has taken practical shape is afforded by the fact that the newcomer has been registered under the title of the "Institution of Gas Engineers," and will presumably at once enter upon an active career, holding meetings at regular intervals.

At the recent meeting of the British Association for the Advancement of Science and Art, held at Leeds, Sir William Thomson read a paper on the unburnt gases contained in the flue gases from gas stoves and burners. This subject is one which has not been systematically investigated before, and is of considerable importance, because it is fashionable among certain so-called sanitary reformers to condemn coal gas as giving off characteristically unwholesome fumes. Many medical gentlemen, especially, give their authority to views of this sort, and say that candles or oil are more wholesome, or, more correctly, less hurtful as regards the products they give off when burnt than coal gas. Those who have investigated the chemistry of the subject know that the products from candles, oil, or gas are similar in character, and, further, that in order to produce a given quantity of light the quantity of air vitiated follows the order above given, the gas being the least offender. For a parlor 16 feet square we frequently find three large gas burners, representing a light of 50 candles. If an oil lamp is used, a light of about 16 candles is considered sufficient; and if candles are used there will not be more than half a dozen. So that a purer atmosphere could be produced by diminishing the consumption of gas to the extent of three or of eight fold.

Many of these advanced scientists have endeavored to account for their prejudice against gas, by assenting that the combustion is not complete, and that poisionous intermediate pruducts, such, for instance, as carbonic oxide, are freely given off in considerable quantity. Sir William Thomson's experiments completely refute supposition of this sort. He operated upon the products of combustion from an Argand, a Bray's flat flame, a Welsbach, a heating stove, in which three of Bray's burners are employed, a "metal" gas fire, in which the flame from eight Bunsen's burners plays upon a network of iron coated with magnetic oxide, an "asbestos" gas fire, comprising 20 atmospheric burners the flame of which plays upon tufts of asbestos fibre projecting from a fire-clay back, and a "condensing" stove. In the Argand the combustion was practically complete, and in the flat flame about 1 per cent. of carbon and a small trace of hydrogen escaped unburnt. This shows that by proper attention in the ways of consuming gas at a suitable pressure, protecting the flame from draught, and using well-made burners, no harm can follow the use of gas for lighting, so far as imperfect combustion is concerned. A paraffine oil lamp was tried and it did not give such good results as the Bray's burner, showing that the oil lamp is not a preventative of unburnt gases. The Welsbach burner was scarcely so good, as it allowed 1½ per cent. of carbon and 0.4 per cent. of hydrogen to escape; but having regard to its lighting effect it will compare favorably with the flat flame, because it will give twice as much light from a given quantity of gas.

The stoves all gave off appreciable quantities of unconsumed products, showing that perfect combustion cannot be obtained when the flame is allowed to impinge upon solid bodies, or when the air supply is restrict-

ed. The necessity for insisting on the use of a flue pipe in connection with appliances of this sort is also clearly indicated. The heating stove answered fairly well with a small gas consumption, but when turned up higher allowed 10 per cent. of carbon and 1.2 of hydrogen to escape unconsumed. The gas fires allowed various quantities, ranging from 4 to 14 per cent. of carbon and 1 to 2½ per cent. of hydrogen, to escape unburned. It is remarkable that the unburnt hydrogen was always much less than the carbon, sometimes only about one-tenth. The condensing stove was by far the worst, and allowed 20 per cent. of carbon to pass unburnt. This is the more remarkable because this make of stove is intended to be used without a flue, and is supposed to give off less harmful products than any other make. The experiments did not extend to the determination of the form in which the unburnt carbon and hydrogen existed, whether free or in combination, or whether partly burnt into intermediate products, such as carbonic oxid.

## ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Mr. William J. Cathcart, City Clerk of Columbia, South Carolina, will to-day open bids for lighting the public lamps, for a year from January 1st, 1891.

Mr. James Kane, of the Doylestown (Pa.) Gas Company, has applied to the Board of Councilmen for permission to erect and maintain a plant and apparatus for the supply of electric lighting currents to the residents of the borough. Another applicant for permission to engage in a similar venture has turned up in the person of Louis E. Myer, and Myer is especially desirous of securing the public lighting—on account of which anxiety he cannot be fairly chided. His method of gilding the pill, however, is little short of unique, as will be understood from an examination of the following excerpt from his "prayer" to the Board: "I propose to illuminate your town with as many arc lamps as you may deem necessary to do the work well, and furthermore propose that the price shall be but very little if any more than the amount you are now expending for gas, and I propose to burn the lights every night." Mr. Myer's gold foil would seem to have the appearance of very well-beaten material; in fact, there is too much flakiness about it. The Council placed both petitions on the table, with the understanding that a special meeting would be called for their consideration on next Monday evening.

Messrs Devoy & Feuerborn, of 708 Pine street, St. Louis, Mo., have entered into a contract with the Laclede Gas Light Company under which they will handle the entire coke product of the latter. In order that the people may be brought to a realizing sense of the virtues of coke as a fuel the contractors have adopted many advertising schemes, some of which are decidedly novel. Among these is a very "catchy" circular, both as to typography and matter, and that our readers may share in its "voice" we herewith reproduce its lines:

"*What is the color of your Lungs?*—Black. Who says so? The Doctors. See their letters to the Mayor on the Smoke Nuisance. What should be the color of your lungs? Pink—that is the natural color. What makes your lungs black? Smoke and soot and sulphur and carbonic acid gas thrown off from all kinds of soft coal. What is the remedy? Use Pittsburgh crushed coke, as prepared for domestic use by Devoy & Feuerborn. Save your lungs at home, even if you must breathe the smoke in the streets. From a sanitary standpoint coke is the best fuel. More than one-half your life is spent at home (or ought to be), therefore if you wish to have pink lungs as the doctors say you ought to have, burn coke. The Gas Company extracts all the gas from it. It makes no soot, no smoke, no sulphurous smell. Nice, clean, cheap fuel. You can use it in grates, base-burner stoves, furnaces and hard coal ranges. Ask your dealer for

DEVOY & FEUERBORN'S CRUSHED COKE,

or send your order to 708 Pine street.

"Try a load. Telephone, 724."

Some months ago the residents of Jamestown, N. Y., were holding indignation meetings and were hobnobbing with each other over the proposition to establish a municipal Gas (natural) Company, the reason for the agitation being the edict on the part of the Company supplying natural gas there to raise the rates. But as the months passed by, however, their enthusiasm lost its oxygen, and the Company received its increased charges. Jamestown, however, must have something to rave over in the line of Nationalism, and now the project is to establish a municipal street railway. From gas to railways, and from railways to —?

Judge Guthrie has refused to grant an injunction prayed for by the Charleston (S. C.) Electric Light Company to restrain the Charleston Gas Light Company from planting poles and stringing wires to carry on the business of electric light supply.

Mr. C. H. Dieffenbaugh, Superintendent of the Tyrone, (Pa.) Gas and Water Company, writing under date of Nov. 24th, says: "By this mail I send you a copy of the Altoona *Tribune* of Nov. 19th; also a copy of the Huntingdon *Local News*, of Nov. 20th, with marked items. I forward the same in the belief that the readers of the Journal would be interested in the fact that natural gas has been struck in the Juniata Valley, east of the Allegheny Mountains. The Camp Meeting Association was sinking an artesian well for the purpose of securing a supply of water for the grounds, when the gas was encountered. Drilling had been going on for several months. Newton Hamilton is a village of about 500 inhabitants, and is situated on the Juniata river and on the line of the Pennsylvania Central Railroad. It is about 73 miles west of Harrisburg, and 48 miles east of Altoona, hence is pretty near the centre of Pennsylvania. The surrounding country abounds in coal, limestone, and all kinds iron ores." The enclosures referred to by our correspondent are as follows; that from the Altoona *Tribune* being given first: "Newton Hamilton, Nov. 18.—A strong flow of gas was struck this afternoon, about 3:30 o'clock, on the Juniata Valley Camp Meeting grounds. The well is now about 700 feet deep and was filled with water to within 17 feet of the top when gas was struck. It blew the water to a height of 40 feet, until the well was empty of water and sand. The excitement runs high." The following is from the other source named by Mr. Dieffenbaugh: "A number of persons from this place visited Newton Hamilton yesterday to see the gas well on the camp meeting ground. The flow of gas that shot the water in the well 40 feet high on Tuesday, subsided in about an hour, and the drillers again began work. They are down about 700 feet, and will continue to drill to the limit of their contract, 800 feet, unless there is such a flow of gas or oil that will prevent further operations. It is not known definitely whether there will be a copious flow of gas or oil or not, but the indications are strong that there is a large quantity of gas in the well at present, and if the well is cased so as to prevent the water from filling it almost to the surface, the flow of gas would be stronger. Mr. Gamble, the driller, who has considerable experience in the gas and oil regions, believes that there is sufficient gas in the well at this time to furnish light for the camp meeting grounds, and also for the town of Newton Hamilton. He says the gas is sweet smelling, as if it was mixed with oil, which leads to the belief that if the well is sunk deeper oil will be obtained. Opinions differ as to which would be the better for the interests of the town, to have a plentiful supply of oil or sufficient gas for use in manufactories. Either commodity would be a blessing to the Juniata Valley, but with the multifarious resources of this section, gas could be turned to better advantage than oil. We hope the brightest expectations of those who are watching the developments at the Newton Hamilton well will be realized, and that we will see a flowing well of oil or gas east of the Allegheny Mountains."

The Citizens' Gas Light Company, of Vincennes, Ind., has brought suit against the city and claims $10,000 damages. The Company, in its complaint, asserts that defendant entered into a contract with it to supply and maintain a certain number of gas lamps on the public streets, the rate to be paid for the service to be $3 per post per month. The council subsequently considered that the rate agreed upon was too high, and when the first bill was rendered a reduction on its face was made without the consent of the Company, and that a similar reduction has been made on each bill presented. Plaintiff further avers that this "cutting" practice is virtually annulling the contract, to which it has never agreed.

On the afternoon of Sunday, November 16th, much inconvenience was occasioned to the residents of Detroit who patronize the Michigan Natural Gas Company, by a sudden intermission in their supply of gaseous fuel. The Company is a customer of the Northwestern Ohio Natural Gas Company, and the trouble at Detroit was occasioned by a break in the "Parent Company's" lines at a point between Findlay and Toledo. The pipe lines were in working order some six hours after the break was discovered, but meanwhile many of Detroit's housekeepers were in a most unpleasantly anxious state.

Mr. H. Eugene Chubbuck, formerly of Utica, N. Y., has been put in charge of the important electric light station of the Thomson-Houston Company at Omaha, Neb.

Mr. Henry H. Johnson, former Superintendent of the Hartford (Conn.) Electric Light Company, is dead. He was much esteemed.

THE office quarters of the United Gas Improvement Company, at Jersey City, N. J., have been removed to 109 Montgomery street. The clerks now are not sorry over the fire that temporarily left them without a home, since their new abode is much more commodious and convenient than that formerly occupied by them.

IT is alleged that Chicago is accomplishing her gasoline lamp lighting in the suburbs at an annual expense of $13.45 per lamp. The last price paid when the work was performed by contract was $17.

A CORRESPONDENT out on the Pacific Coast writes that the complaints recently made in Fresno by the gas consumers about the poor quality of gas that was sent out for a time were well founded, but the Company could not in any sense be held blamable, for its coal supplies were both deficient in quantity and quality. In further mention of the matter, our correspondent says: "We are at the mercy of the market, which is away up, just now. The Australian strike has made coal very scarce, and a lot of 300 tons, which had been offered to us at $7 per ton, we had to pay $15 for, because of the non-arrival of coal that we had contracted for. The $15 article was not fit for gas making purposes; but we have to do the best we can with the only material available. When the 'Garfield' arrives at San Francisco, we shall speedily be out of our difficulties, as that vessel has several hundred tons of coal on board to our order. The people, however, have been very considerate since the causes that operated to our disadvantage have been explained to them."

ABOUT a fortnight ago Engineer James B. Stewart turned steam on to the new pumps at the Duluth (Minn.) Gas and Water Company's pump house, at the East End, in that city, the start up being witnessed by the officers and directors of the Company. The pumps, two in number, and operated by the type of engine known as Gaskell's compound horizontal pumping engine, are of the double-acting plunger sort, 19½ inches diameter, with 36-inch stroke. The capacity is 6,000,000 gallons per day, against a static head of 285 feet. They are rigged so as to act in concert or independently, and were built by the Holly Manufacturing Company, under the superintendence of Mr. James F. Casey, of Lockport, N. Y. The old pumps, three in number, have a combined daily capacity of 5,000,000 gallons.

CERTAIN capitalists of Butte, Mont., have applied to the Bozeman City (Mont.) Council for a franchise for a Gas Company at that point. Under the agreement the Company will expend at least $50,000 in plant, etc., will commence work by May 1st, and will have the works in operation within a year from the commencement of the same. Bozeman is the capital of Gallatin county, Mont., and is 95 miles southeast of Helena. An affluent of the Gallatin river runs through it. The chief charms of the place are its climate and magnificent scenery. It has grown very rapidly in the past 10 years, as can well be imagined when it is stated that it gave shelter to 168 souls in 1880, whereas now it can boast of a population of not less than 5,000.

MAYOR VANCLEEF, of New Brunswick, N. J., has presented to the City Councils a complaint against the local gas company, alleging that the pipe through which it conveys its naphtha supplies from the railroad depot to the works is a menace to the lives of the citizens. Mayor Van Cleef, perhaps, would be better satisfied if the fluid-vapor were transported in barrels, still the practice would be vastly more dangerous than is the one at present complained about. In fact, the *safest* as well as the most economical method of oil transportation is by means of pipe lines, carefully inspected.

THE mains of the Providence (R. I.) Gas Company are being extended through Taunton avenue, from Broadway into Seekonk, East Providence.

IT is said that construction work on the new gas plant at Sterling, Ills., is underway.

SOME days ago a slight fire broke out in the roof of the scrubbing department of the Neenah and Menasha (Wis.) gas works. The damage was less than $100, but at one time it looked as if the flames might make considerable headway.

MESSRS. F. B. ENSLOW, D. W. Emmons and J. H. Russell are said to have under consideration the project of building a gas works at Huntington, West Va. In fact, the gentlemen are already committed to the project. This place is a post town of Cabell county, West Va., is on the Ohio river at a point 20 miles above Ironton, O., and just below the mouth of the Guyandotte river. It is an important place in the Chesapeake and Ohio Railroad system, and is 52 miles west of Charleston. Population, about 6,500.

THE Fire and Police Committee of the San Francisco Board of Supervisors are considering the advisability of adopting an order, presented by Supervisor Whelan, prohibiting the suspension of electric wires over or upon the tops or roofs of buildings, excepting only buildings occupied exclusively for the business of furnishing electric light or motive power. The third section of the order reads: "Any person violating this ordinance shall be deemed guilty of a misdemeanor and be fined not less than $500, or be imprisoned in the County Jail for not more than 6 months, or by both such fine and imprisonment. The fourth section empowers and orders the Chief Engineer of the Fire Department to remove said wires from buildings and to continue to do so. The last section repeals order No. 2,163, "prohibiting the suspension of electric wires over or upon the roofs of buildings, etc."

THE suit brought by Miss Tillie Smith against the St. Louis Illuminating Company and the Western Union Telegraph Company, in which complainant asked for $5,000 damages, has been settled by compromise. Plaintiff, on last New Year's Day, while walking along Seventh street, near Morgan street, came in contact with a live electric light wire, which had become loosened from its fastenings to the point of dangling over the street. Miss Smith sustained a severe shock, and was badly burned. Hence the suit, in which she alleged culpable negligence on the part of the defendants. The amount of the compromise payment was not made public, but the case is a notable one, in that it was the first of the sort brought in St. Louis, and that defendants compromised rather than that the issue be determined on its merits.

AMENDED articles of incorporation of the Grand Island, (Nebraska,) Light and Fuel Company have been filed. The principal change is in the capitalization, which is brought up to $300,000, payable on call of the Directors. The incorporators are Charles A. Wiebe, Geo. D. Hetzel, Chas. Wasmer, Hayward G. Leavitt and W. R. King.

A CHARTER for the Palmer, (Mass.) Gas Light Company has been issued. The capital is placed at $25,000. Officers: President, C. E. Fiske; Treasurer, Charles B. Fiske.

THE Pawtucket, (R. I.,) *Times* is responsible for the following: "The work on the addition to the Gas Company's plant is almost completed, having been pushed vigorously. The new building in which water gas is to be manufactured is all completed and the machinery is all in the structure. The gas holder is not quite complete but it will be in about two weeks, and then the manufacture of water gas will commence. The erection of the gasholder has been quite a difficult job from the nature of the foundation. It has been necessary to blast in the solid rock, and the holder will be one of the best of its kind. The water gas is to be mixed into the coal gas which the Company now manufactures, and the addition of the former will impart an added brilliancy to the gas used. Naturally, the cost of making the water gas is not as great as coal gas, yet only a very small proportion of the former is used. The Company's representatives claim that on account of the added brilliancy which the water gas imparts the public will find a saving on account of its manufacture, as, of course, in that event it will not be neeessary to burn as large a flame as heretofore. In all probability inside of a month the plant will be in good working order, and then the people will be enabled to judge for themselves as to the value of the water gas."

IT is said that Mayor Macrae, John Beno, ex-Mayor Rohrer, A. B. Walker, Burke & Hewitt and others have become interested in the formation of a fuel gas company, for Council Bluffs, Ia., and that it is proposed to work under "the patents of Prof. Hall, of Chicago." They are talking very loudly and glibly over what they are going to do and the money they *are going* to make; but we fear about the only ones that will eventually come out whole out of the attempt will be those who represent "Prof. Hall, of Chicago."

The Milwaukee *News* says that some days ago a test of the heating values of different gases was made at the Milwaukee Company's works, in the presence of the Judiciary Committee of the Common Council. The result was that it was shown that 8.5 cubic feet of pure water gas were required to raise 10 pounds of water to the boiling point, whereas the same result was gained by the use of 4.9 cubic feet of coal gas or by the use of 3.2 cubic feet of carbureted water gas. This ought to open the eyes of the Council to the true value of the promises made to Council, by Messrs. Flanders and Mariner, who ask for a charter for a fuel gas company for Milwaukee, proposing to distribute a non-carbureted water gas for fuel purposes.

## Gas Stocks.

**Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks,**

16 Wall St., New York City.

December 1.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

| | Capital. | Par. | Bid | Asked |
|---|---|---|---|---|
| Consolidated | $35,430,000 | 100 | 96¼ | — |
| Central | 500,000 | 50 | 90 | 95 |
| " Scrip | 220,000 | — | 95 | 100 |
| Equitable | 4,000,000 | 100 | 119 | 122 |
| " Bonds | 1,000,000 | — | 113 | 115 |
| Harlem, Bonds | 170,000 | — | — | — |
| Metropolitan, Bonds | 658,000 | — | 110 | 115 |
| Mutual | 3,500,000 | 100 | 115 | 120 |
| " Bonds | 1,500,000 | — | 100 | 102 |
| Municipal, Bonds | 750,000 | | — | — |
| Northern | | 50 | — | — |
| " Bonds | 150,000 | — | — | 100 |
| Standard Gas Co— | | | | |
| Common Stock | 5,000,000 | 100 | — | 45 |
| Preferred | 5,000,000 | 100 | — | 90 |
| Yonkers | | 50 | 112 | — |
| Richmond Co., S. I. | 346,000 | 50 | — | — |
| " Bonds | 20,000 | — | — | — |
| **Gas Co's of Brooklyn.** | | | | |
| Brooklyn | 2,000,000 | 25 | 115 | 116 |
| Citizens | 1,200,000 | 20 | 98 | 100 |
| " S. F. Bonds | 320,000 | 1000 | 100 | 103 |
| Fulton Municipal | 3,000,000 | 100 | — | 136 |
| " Bonds | 300,000 | | 100 | 105 |
| Peoples | 1,000,000 | 10 | 85 | 90 |
| " Bonds (7's) | 368,000 | — | 100 | — |
| " " (6's) | 94,000 | — | 100 | — |
| Metropolitan | 1,000,000 | 100 | 105 | 110 |
| Nassau | 1,000,000 | 25 | 130 | — |
| " Ctfs | 700,000 | 1000 | 95 | 100 |
| Williamsburgh | 1,000,000 | 50 | 128 | 130 |
| " Bonds | 1,000,000 | — | 108 | 112 |
| **Out of Town Gas Companies.** | | | | |
| Boston United Gas Co.— | | | | |
| 1st Series S.F. Trust | 7,000,000 | 1000 | — | 87 |
| 2d " " " | 3,000,000 | 1000 | — | 75 |
| Bay State Gas Co.— | | | | |
| Stock | 5,000,000 | 50 | — | 50 |
| Income Bonds | 2,000,000 | 1000 | 95½ | — |
| Buffalo Mutual, N. Y. | 750,000 | 100 | 90 | 95 |
| " Bonds | 200,000 | 1000 | 95 | 100 |
| Citizens, Newark | 1,000,000 | 50 | 155 | 160 |
| " " Bonds | 45,000 | — | — | — |
| Chicago Gas Company | 25,000,000 | 100 | 37⅜ | — |
| Chicago Gas Light & Coke Co.— | | | | |
| G't'd Gold Bonds | 7,650,000 | 100 | 84¾ | 85½ |
| Equitable Gas & Fuel Co., Chicago, Bonds | 2,000,000 | 1000 | — | 98 |
| People's Gas and Coke Co., Chicago— | | | | |
| 1st Mortgage | 2,100,000 | 1000 | — | 100 |
| 2d " | 2,500,000 | 1000 | 94 | 98½ |
| Consumers Gas Light Co., Jersey City | 2,000,000 | 100 | — | 30 |
| Bonds | 600,000 | 1000 | 80 | — |
| Cincinnati G. & C. Co. | 6,500,000 | 100 | 204 | 205 |
| Consumers Toronto | 1,000,000 | 50 | 190 | 200 |
| Central, S. F., Cal | | | 80 | 90 |
| Capital, Sacramento, Cal | | | 58 | |
| Consolidated, Balt | 11,000,000 | 100 | 44½ | 45 |
| " Bonds | 6,400,000 | | 107 | 107½ |
| Citizens Gas Lt. Co., Rochester, N. Y. | 500,000 | — | 85 | 110 |
| Bonds | 250,000 | | — | — |
| Hartford, Conn | 750,000 | 25 | 102 | 108 |
| Jersey City | 750,000 | 20 | 165 | 170 |
| Louisville, Ky | 2,570,000 | 50 | 125 | 130 |


## SITUATION WANTED

**As Superintendent of Gas, Electric Light or Water Works,**

By an experienced man who can give good references. Has had considerable experience in the construction of gas and water works. Address

808-2 "J. G.," care this Journal

## Situation Wanted

By a young man 21 years of of age

**To Superintend or Assist in Managing a Gas Works.**

Has had experience, and can give the best of references.

808-1 Address "E. B.," care this Journal.

## Position Wanted

**As Superintendent of Gas Works.**

Has had a large experience in the manufacture and distribution of gas and construction and extension of gas plants. A1 references. Address

803-tf "E.," care this Journal.

## POSITION WANTED.

The advertiser has had 20 years' practical experience in designing, constructing, and operating Coal and Water Gas Apparatus. A good draughtsman and total abstainer. A position as Superintendent of a small works requiring improvements preferred. Address

807-2 "G. T.," care this Journal.

## CALIFORNIA GAS WORKS For Sale.

Several Coal Gas Plants, in both Southern and Northern California, now profitably operated and constantly increasing in value. Practical gas men, with $7,500 to $15,000 to invest, can secure controlling interest and superintendency. Very desirable places of residence. Satisfactory reasons for selling

"SECRETARY," 123 Beale Street,
807-13t San Francisco, Cal.

## Coal Tar For Sale.

**PROPOSALS** for the entire make of Tar in the works of the **Pittsburgh Gas Company,** for five (5) years from the 1st day of January next, will be received at their Office, No. 77 Sixth Avenue, Pittsburgh, Pa., until the 13th day of December next, at noon.

Bids to be by the net ton (of 2,000 pounds) of coal carbonized. Tar to be delivered in tar tank at works. Right to use sufficient tar for Company's own purposes, and to reject any or all bids, reserved.

804-6 JOHN H. McELROY, Engineer.

## The American Gas, Light & Heat Co.,

OF

**249 S. 6th St., Phila., Pa.,**

Are now prepared to erect plants of their Oxy-Hydrocarbon Process, to carburet coal gas up to any given or named candle power required for general consumption (for instance, from 20 to 25 candles), and at a cost not to exceed one and three-quarters (1¾) cents per candle power per 1,000 cubic feet increased, with a permanent and perfectly *fixed* gas, *not a vapor*—a gas that will whiten the whole output of the works.

This gas can be furnished at a cost less per 1,000 cubic feet than the coal gas may be costing the company.

Our system is such that we can furnish plants that will carburet 50,000 cubic feet in 24 hours, or three or four million feet in the same length of time. *One* of our large benches or plants would be capable of generating 100,000 cubic feet of gas in 24 hours, which would raise the candle power on 2,000,000 feet (taking as a standard coal gas at 15 candles) 3 candles on the 2,000,000 feet, enabling the works to deliver to consumers an 18 candle gas; or, enlarging our plant, the candle power may be increased as desired, at the same cost per candle power, less interest on plant.

This is much less per candle power than it can be furnished by the use of cannel coal or by vaporizing naphtha. With our process we improve the whole output in color—viz., whiten the flame with the oxygen, as well as furnishing a *thoroughly fixed* gas, and no possible danger of separation as there is with vapor.

Correspondence solicited.

**J. J. NEWELL, Sec'y.**

**September 4, 1890.**

COMPLETE STEAM PUMP
10 SIZES FROM $7 TO $75
FOR DRIVE WELLS & ETC.
WRITE FOR PRICES AND DESCRIPTIVE CIRCULARS.
VAN DUZEN & TIFT
SOLE MAKERS.
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# Water Gas! Fuel Gas!

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**Or Murray Hill Hotel, New York City.**

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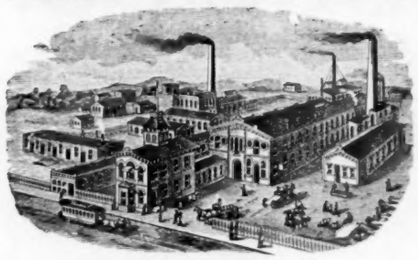

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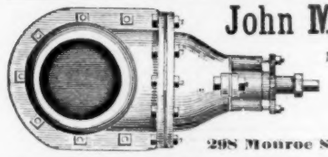

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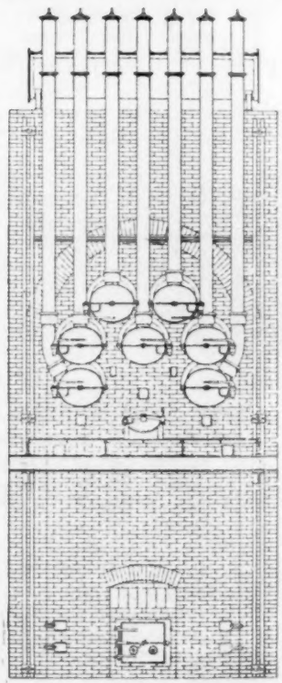

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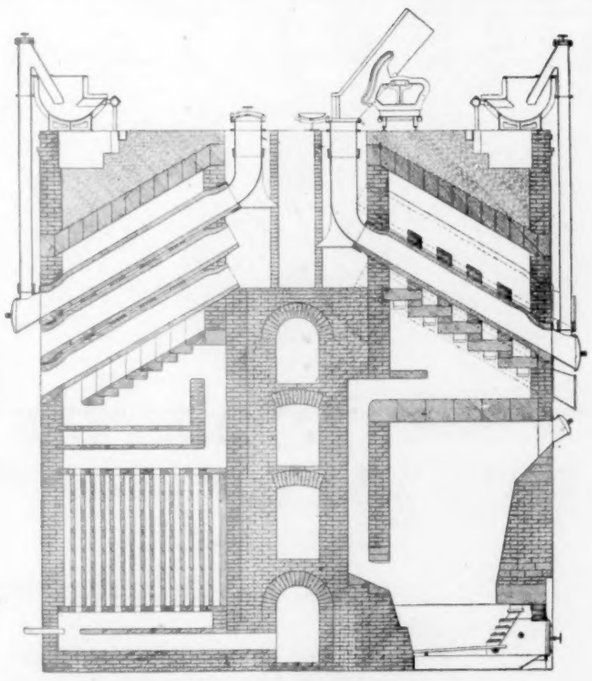

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IRON TRUSSES, IRON TRAVELING CRANE,
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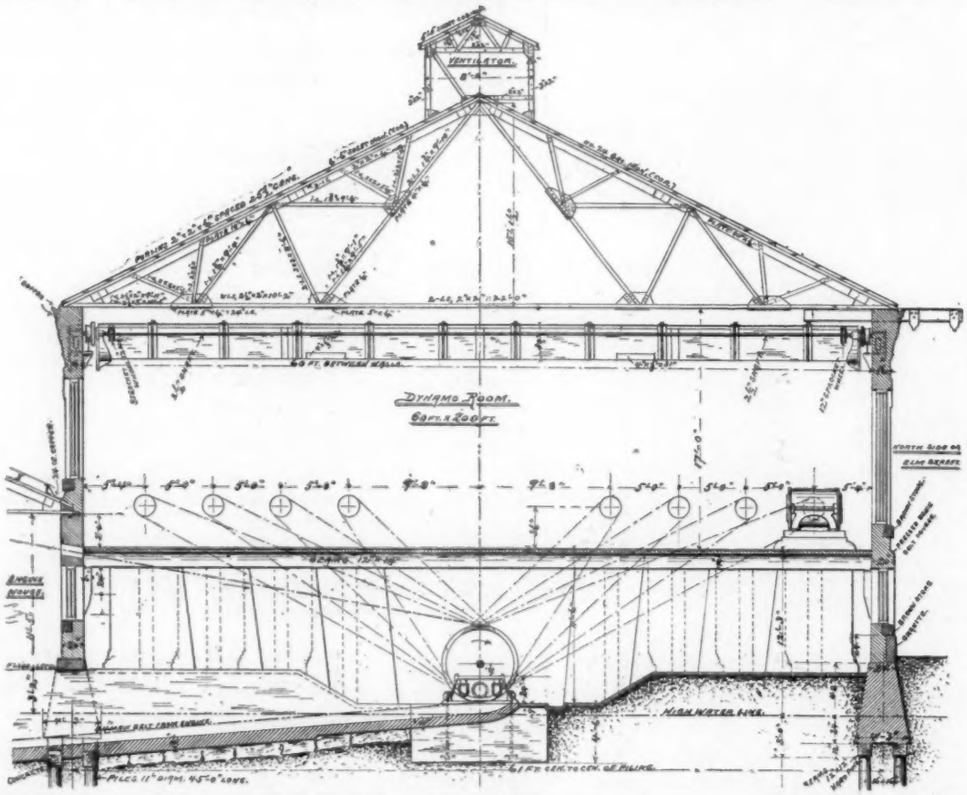


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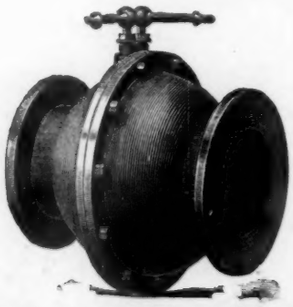

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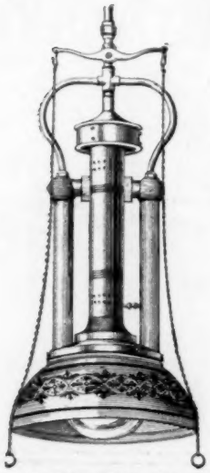

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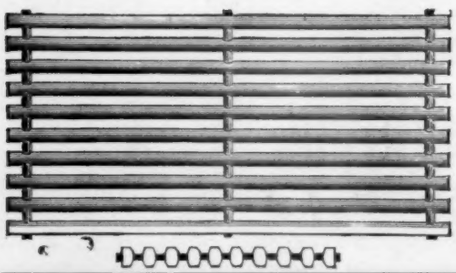

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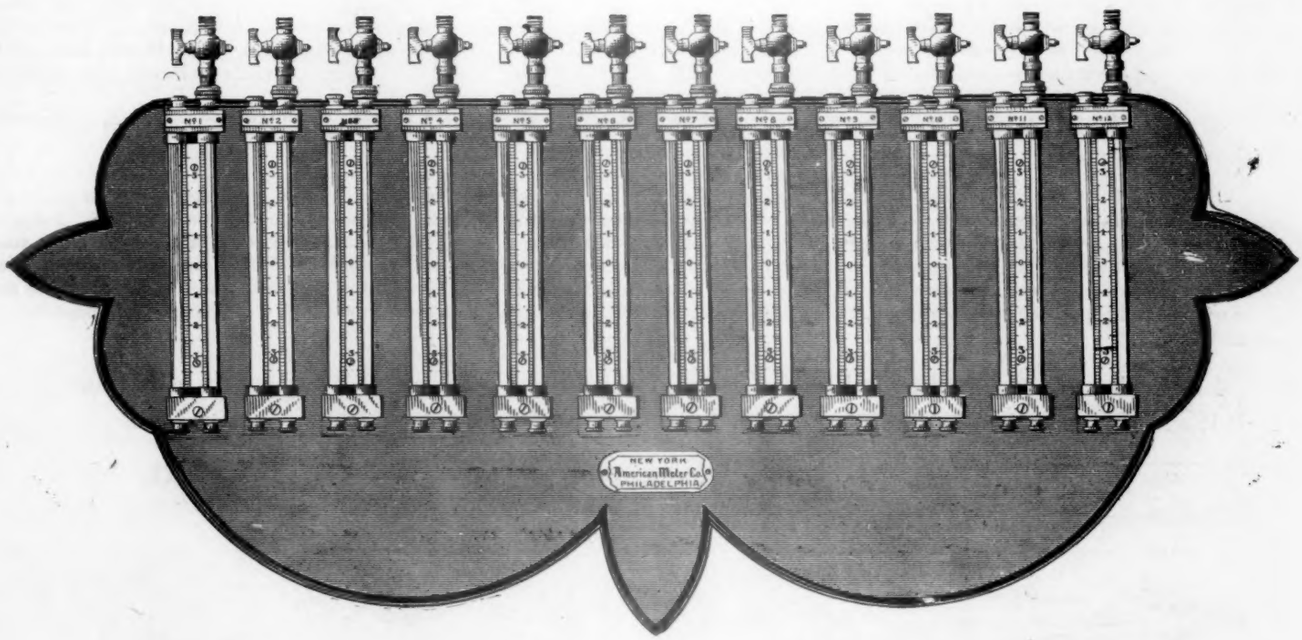


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The following Engineers have personally given permission to refer to them:

G. C. Trewby, Esq., Engineer-in-Chief of the Gas Light and Coke Co., London. The manufacturing plant at Beckton is built in complete sections of 3,000,000 cubic feet capacity each. A Walker Tar Extractor has been fitted to each one of these sections. This was done after a long and thorough trial on one of its sections. The Tar Extractor has been supplied to other works of the Gas Light and Coke Co., including those of which John Methven, Engineer of the Gas Light and Coke Co. at the Nine Elms Station, is in charge. Also to G. E. Stevenson, Peterborough Gas Works; B. Green, Mitcham and Wimbledon Gas Works; W. H. Smith, Bedford Gas Works; F. Linging, Norwich Gas Works; J. T. Browning, Colchester Gas Works; S. B. Darwin, Portsmouth Gas Works; J. McCrae, Dundee Gas Works; W. J. Wells, Stamford Gas Works; J. M. Darwin, Longton Gas Works; J. Paterson, Warrington Gas Works; and J. Coulter, of the Dundalk Gas Works. All of the foregoing gas works are located in Great Britain.

Mr. Charles A. Gerdenier, Superintendent of the Bridgeport (Conn.) Gas Light Company, writes as follows, under date of Dec. 3, 1887:

"The C. & W. Walker Tar and Carbonic Acid Extractor has been in operation at these works for the past six weeks, and is an unqualified success. It removes every particle of Tar from the gas in once passing through the apparatus, and a large percentage of the Carbonic Acid. I also feel quite sure that it prevents the formation and deposit of Naphthaline, because since I started the Washer I have had no stoppages from this cause. These works have been seriously troubled with Tar for many years, and I have used several kinds of apparatus and every expedient which has come to my attention for dealing with the difficulty, but without success. The Walker apparatus occupies comparatively small space, is less expensive than other systems, and requires but little attention. I carry 2½-inch seal, and have an automatic tar delivery valve. This Tar Extractor is indispensable to gas makers."

I have taken the Agency for the United States for this apparatus, and am now prepared to make contracts to erect it on the premises of any Gas Company. It would be manufactured in the following sizes:

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| No. 1, | 50,000 | to | 100,000 | cu. ft. | per | 24 hrs., | 3 | ft. | square, | 5 ft. deep. |
| No. 2, | " | " | 125,000 | " | " | " | 4 | " | " | " " |
| No. 3, | " | " | 250,000 | " | " | " | 5 | " | " | " " |
| No. 4, | " | " | 500,000 | " | " | " | 6 | " | " | " " |
| No. 5, | " | " | 750,000 | " | " | " | 7 | " | " | " |
| No. 6, | " | " | 1,000,000 | " | " | " | 8 | " | " | " |
| No. 7, | " | " | 1,250,000 | " | " | " | 9 | " | " | " " |
| No. 8, | " | " | 1,500,000 | " | " | " | 10 | " | " | " " |
| No. 9, | " | " | 2,000,000 | " | " | " | 12 | " | " | " " |
| No. 10, | " | " | 3,000,000 | " | " | " | 15 | " | " | " " |

This Tar Extractor will perform its work with about one-fourth the usual back-pressure heretofore required. It is simple in construction, and can be supplied at a very reasonable price—less than any other ever before introduced. Satisfactory results will be guaranteed in every instance.

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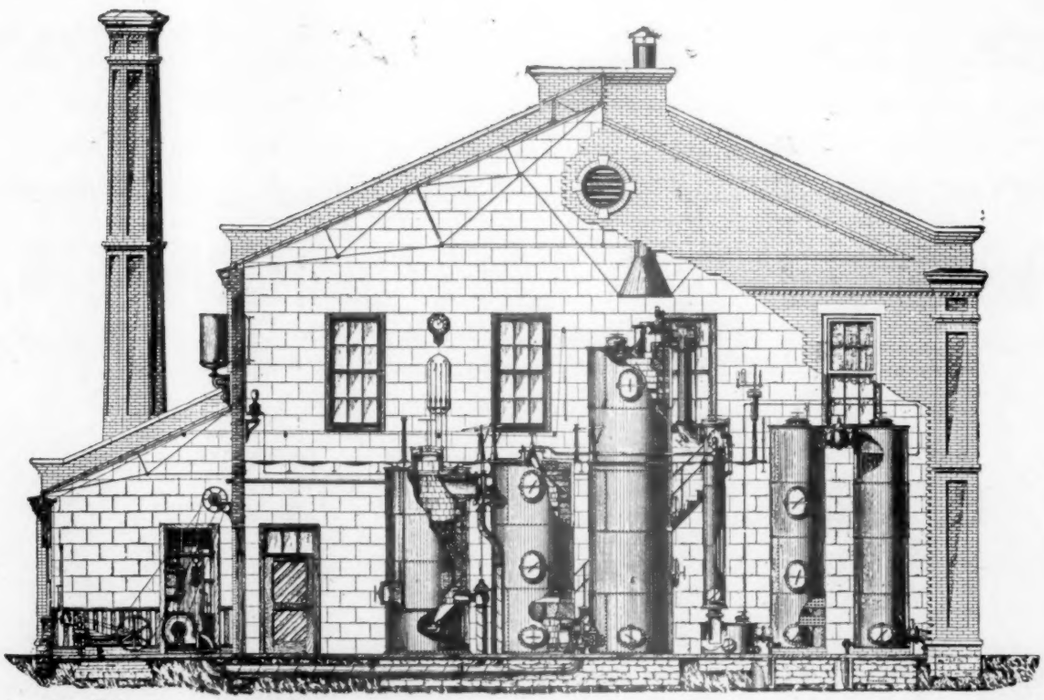

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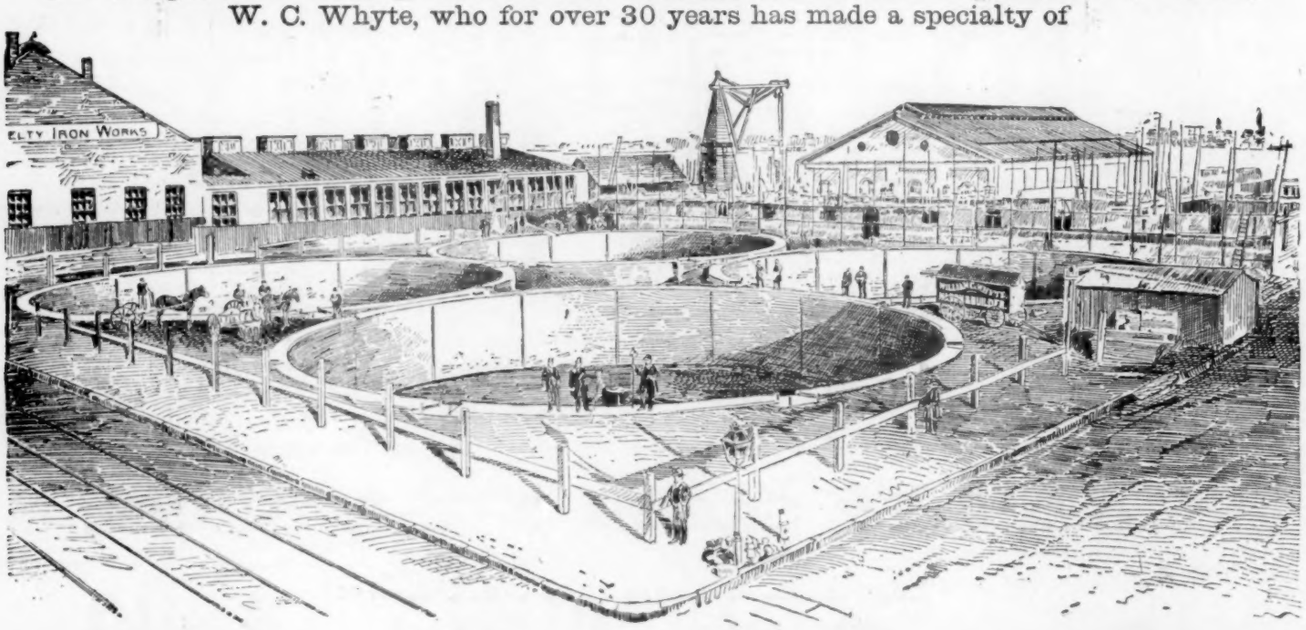


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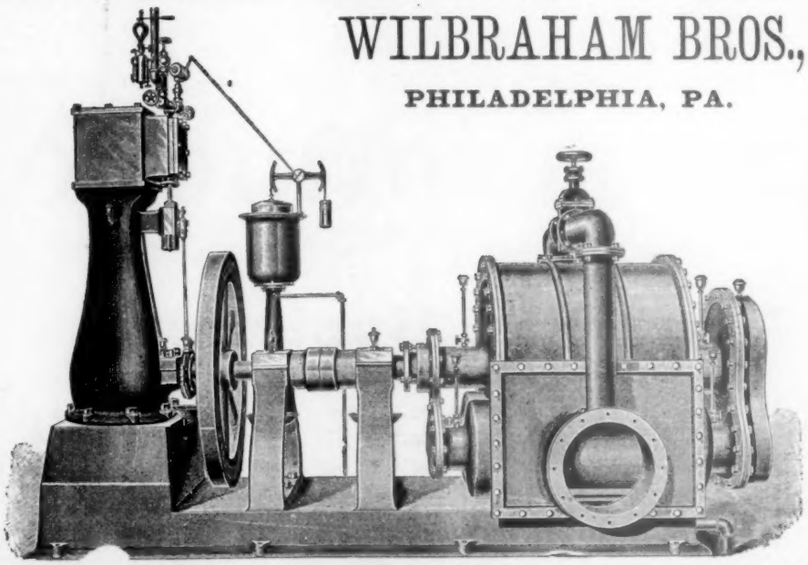

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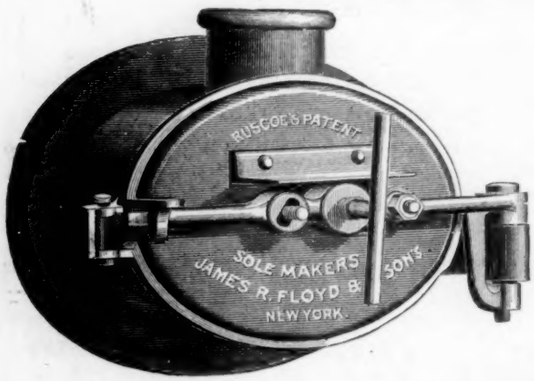


This Lid and Fastener is specially designed for taking up the wear and tear caused by refacing the Mouthpiece and Lid, hitherto in a large measure overlooked; and, in addition, from the special way in which the Lid is attached to the Cross-bar, the Lid has free action, and thus secures a more uniform scrape over the whole surface when being forced home by the Screw, the closing pressure being much more equally distributed than in any other form of fastening.

The Lid itself is well ribbed, internally and externally, thus securing the tightest, strongest, and simplest Lid in the market, and the most easily adapted to existing Mouthpieces.

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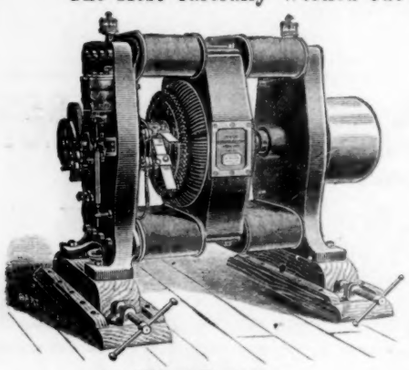

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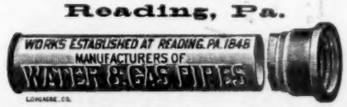


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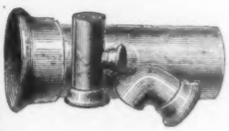

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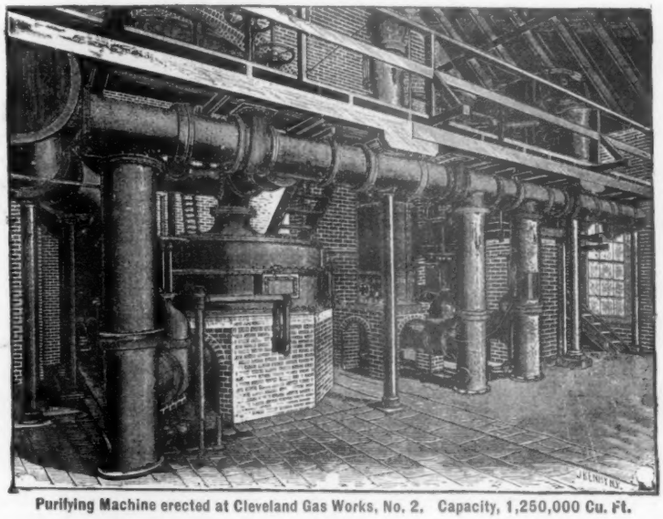

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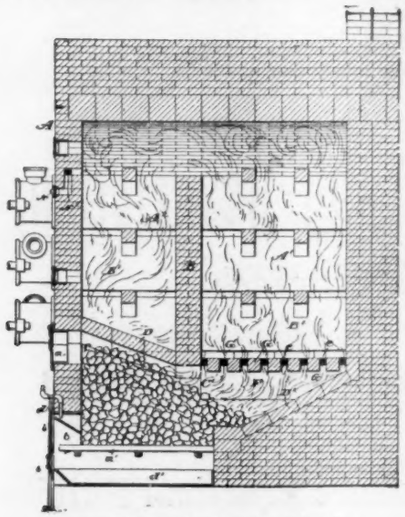

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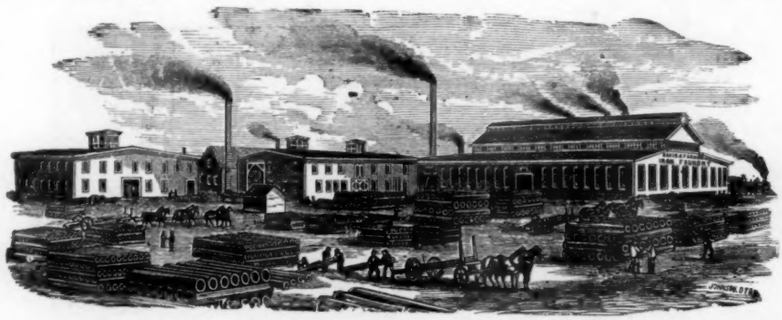

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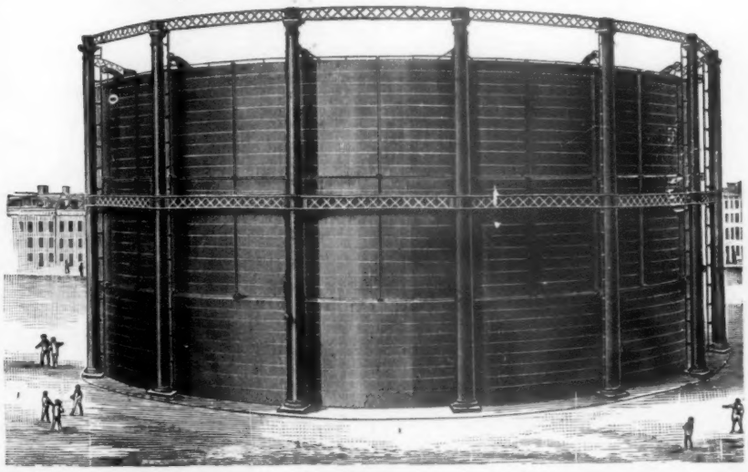

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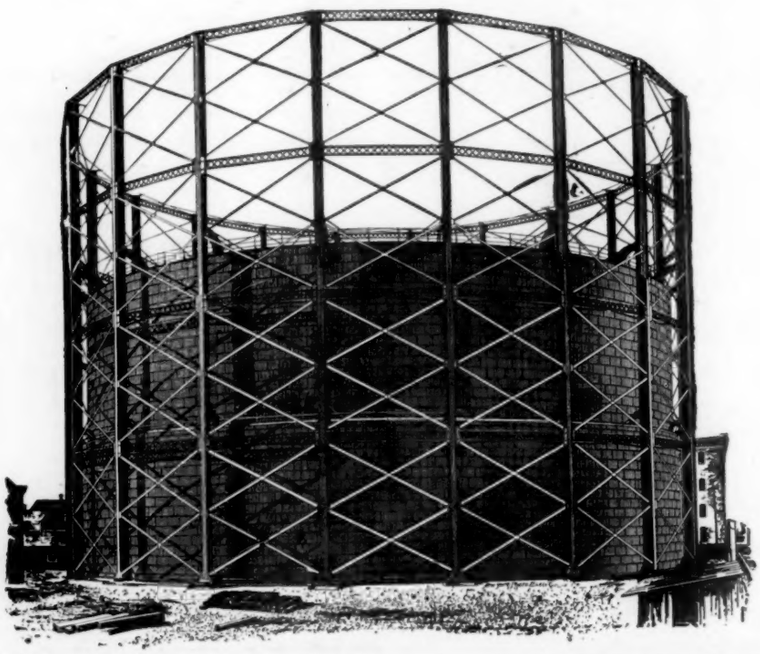

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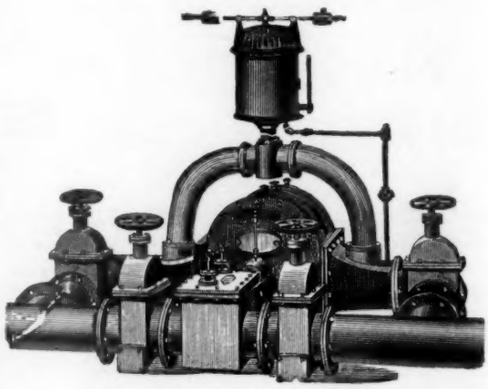

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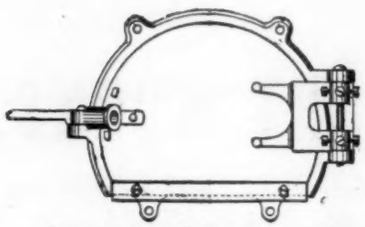

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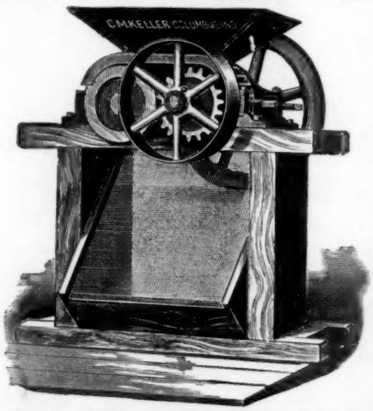


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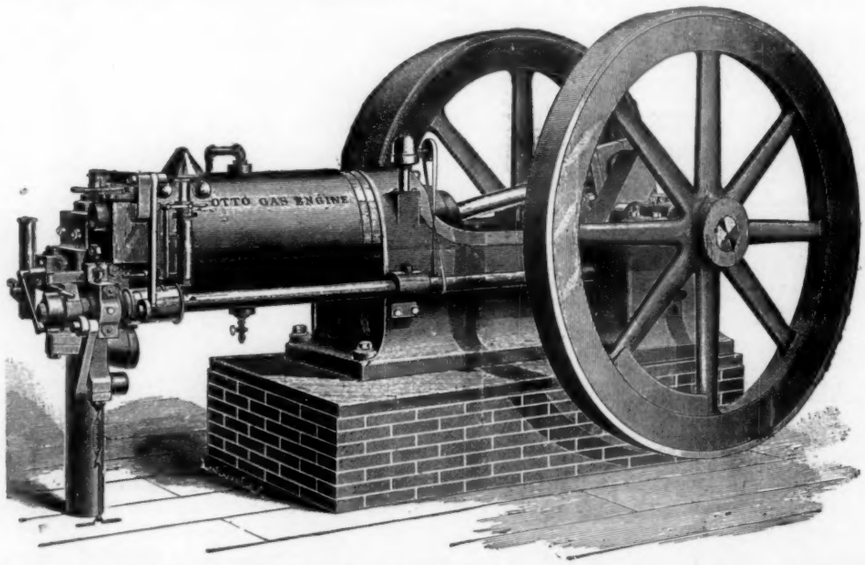


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